RIVER FEATURES ASSOCIATED WITH CHINOOK SALMON SPAWNING HABITAT IN SOUTHWEST ALASKA

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A

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Abstract

Chinook salmon *Oncorhynchus tshawytscha* are a highly valued traditional, subsistence, and commercial resource in Southwest Alaska. Stream habitat availability is a major component influencing salmon productivity. The objective of this study is to identify river features associated with spawning habitat, and describe upper and lower boundaries of Chinook salmon spawning on the Tuluksak River. River distances, elevation, salmon locations, spawning sites, and habitat observations were collected along 75 rkm (river kilometers) of the Tuluksak River primarily within the Yukon Delta National Wildlife Refuge. Habitat and salmon observations were grouped into strata along the length of the river for comparison and analysis. Chinook salmon were observed spawning in the upper 45 rkm of the study area. Map-based observations of elevation and channel sinuosity correlate better with Chinook salmon spawning than in stream habitat measurements along the Tuluksak River. The upper boundary of Chinook salmon spawning in the Tuluksak River was outside of our study area. The lower boundary for Chinook salmon spawning habitat on similar rivers might be determined by examining elevation, sinuosity, and channel features from remote images or maps prior to conducting field studies.

Key words: Chinook salmon, spawning habitat, habitat selection, habitat boundaries

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Introduction

Pacific salmon *Oncorhynchus* spp. are ecologically, economically, and sociologically import fishes in northwestern North America (Knudsen et al. 1999). The carcasses of salmon that return to their natal rivers to spawn are an important source of nutrients in freshwater systems (Gende et al. 2002, Knudsen et al. 2003, Plumb and Harper 2008), providing food for mammals, birds, insects, and other fish. The economic value of salmon fisheries in the Kuskokwim river has approached nearly $1million dollars (1998-2002 average), out of a statewide salmon harvest value of $260 million (Woodby et al. 2005). In rural indigenous populations, salmon are used for subsistence and provide a traditional food source for the local people (Andrews and Peterson 1983, Fall et al. 2003, 2007).

Management of salmon fisheries is usually accomplished using mathematical models of spawners and subsequent recruits to predict and define escapement goals (Ricker 1954, Molyneaux and Brannian 2006, Linderman and Rearden 2007). However, these models generally do not take into account the underlying availability and productivity of the habitat used by salmon (Piccolo et al. 2009). It is possible that exploited salmon stocks appear stable at a much lower escapement level than could be biologically supported. The carrying capacity of salmon streams and their potential productivity is a complex problem driven by numerous factors of habitat availability, suitability, and environmental variability.

One important aspect of understanding and quantifying the carry capacity of salmon streams is the amount of habitat available for different life stages, such as for spawning and egg development (Groot and Margolis 1991, Raleigh et al. 1986, McHugh and Budy 2004). What constitutes appropriate salmon spawning habitat has been defined by a several habitat characteristics such as temperature (Murray and McPhail 1988,), substrate and subsurface flow (Vronskiy 1972, Vronskii and Leman 1991, Geist and Dauble 1998), and depth and velocity

(Neilson and Banford 1983, Hanrahan et al. 2004). While Chinook salmon are capable of spawning in a wide range of habitat, they favor areas of through gravel flow. Eggs will only successfully hatch if their parents have chosen locations with sufficient depth to avoid drying or freezing, adequate water flow to maintain oxygenation, and in substrate that is resistant to scour or siltation.

Because of their large size and high quality flesh, Chinook salmon *O. tshawytscha* are often considered the most valued of the Pacific salmon in many river systems (Andrews and Coffing 1986, Groot and Margolis 1991) and were thus selected as the species for this study. As a large, powerful fish, they are capable of spawning in habitat that may be inaccessible or undesirable spawning areas for other salmon species (Groot and Margolis 1991). Stream habitats are difficult to assess in remote areas of Alaska with limited access. However, larger scale features such as passage barriers, thermal limits, impenetrable substrate, unsuitable depth, velocity, or other physical factors may be present that restrict salmon from using an entire river as spawning habitat. Identification of such restrictive habitat features may be useful for guiding investigations of spawning habitat availability.

The Tuluksak River, a tributary of the Kuskokwim River in southwest Alaska, was selected as the site for this study because of the presence of historic and contemporary salmon data collection. Salmon data collection from the Tuluksak River is primarily related to escapement estimates. The Unites State Fish and Wildlife Service (USFWS) operated a weir from 1991 to 1994 and from 2001 to 2007 on the Tuluksak River to collect escapement information and data on population characteristics such as age, size, and sex of returning salmon (Harper 1995a, b, c, 1997, Gates and Harper 2002, 2003, Zabkar and Harper 2004, Zabkar et. al 2005, 2006, Plumb et. al, 2007, Plumb and Harper 2008). Aerial surveys have been conducted

intermittently by the Alaska Department of Fish and Game (ADF&G) on the Tuluksak since 1965 (personal communication, J. Linderman, ADF&G).

The objectives of this study are to 1) collect basic stream habitat information from the Tuluksak River, 2) document the distribution of Chinook salmon spawning and find upper and lower limits, 3) determine how Chinook salmon spawning area is limited by river features within the study area, and 4) identify which stream habitat variables correlate to Chinook salmon spawning habitat. This study was conducted in 2002 and 2003.

Methods

Study site.— The Tuluksak River flows into the Kuskokwim River, approximately 218 river kilometers (rkm) from the mouth of the Kuskokwim River (Gates and Harper 2002). The village of Tuluksak lies at the confluence of the Tuluksak and Kuskokwim rivers 86 rkm upstream of Bethel, and has a population of approximately 400 residents (Figure 1).

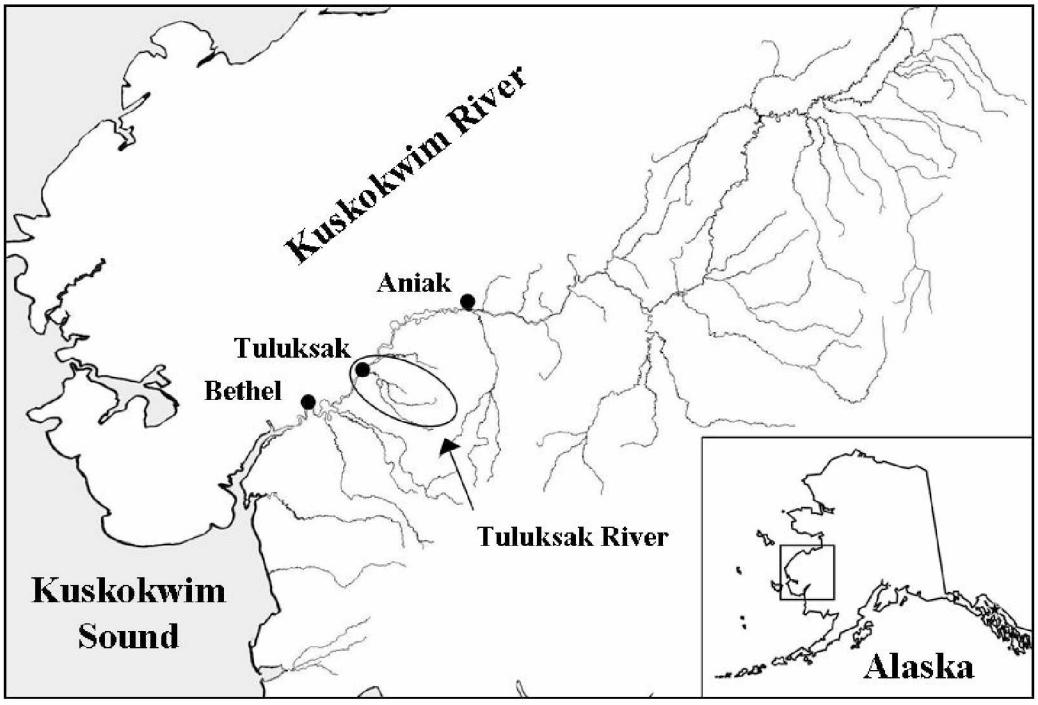

Figure 1. Location of the Tuluksak River, Alaska.

Five species of Pacific salmon utilize the Tuluksak River, with chum , coho *O. kisutch*, and Chinook returning with the largest numbers. Much smaller numbers of sockeye *O. nerka* and pink *O. gorbuscha* also return to the river (Harper 1995a, b, c, 1997, Gates and Harper 2002, 2003, Zabkar and Harper 2004, Zabkar et. al 2005, 2006, Plumb et. al, 2007, 2008). Chinook salmon return to the Tuluksak River in a single run from late June to September. Alt (1977) described the Tuluksak River in two parts, roughly above and below the 2001-2007 weir site at the channel split. The upper part (above the channel split) was characterized as excellent spawning habitat for grayling, char and salmon, with 30,000 to 50,000 chum salmon and 1,500 Chinook salmon observed. The lower part has mostly sandy or muddy substrate, with banks heavily vegetated by willow, spruce, birch, cottonwood, and grasses (Alt 1977, and personal observations).

The Tuluksak River drains the northwest part of the Kilbuck Mountains, with an estimated drainage area of 2,150 square kilometers (Collazzi and Maurer 1986). The Fog River is the only major tributary that enters the Tuluksak River (Harper 1995c) and joins the Tuluksak River below the weir. There are no lakes at the headwaters of the Tuluksak River; tributaries include Granite, Dugout, Dry, Slate, Bear, California, Rock, and Bonanza creeks within gold mining areas, and Otter Creek, which joins the Tuluksak about 36.5 km above the weir site (Figure 4). The Tuluksak River drains a large area of flat tundra. Annual precipitation in the area is about 50 cm which falls mainly between June and October (Harper 1995c). Freeze up occurs in late November, and the river experiences break-up in early May (Harper 1995c).

The upper Tuluksak basin is comprised of isolated masses of permafrost and exposed bedrock, and "tightly folded Cretaceous rocks with interbedded layers of graywacke and shale, intruded by Cretaceous granitic rocks" (Collazzi and Maurer 1986). The foothills have Jurassic

volcanic and sedimentary rocks. Below the foothills in the lowlands, the basin is comprised of thick to thin permafrost with Quaternary silt and sand deposits (Collazzi and Maurer 1986).

The study area for this project extends from the US Fish and Wildlife Service weir to just above the boundary of the Yukon Delta National Wildlife Refuge. The refuge boundary is approximately 73 rkm upstream from the 2001-2007 Tuluksak weir site. The 1991-1994 weir was approximately 16 rkm upstream of the current weir site (Molyneaux and Folletti 2007) (Figure 2). In this paper, data points are referenced in relation to the 2001-2007 weir, which is located 248 rkm from Kuskokwim Sound, 56 rkm above the confluence of the Tuluksak and Kuskokwim rivers.

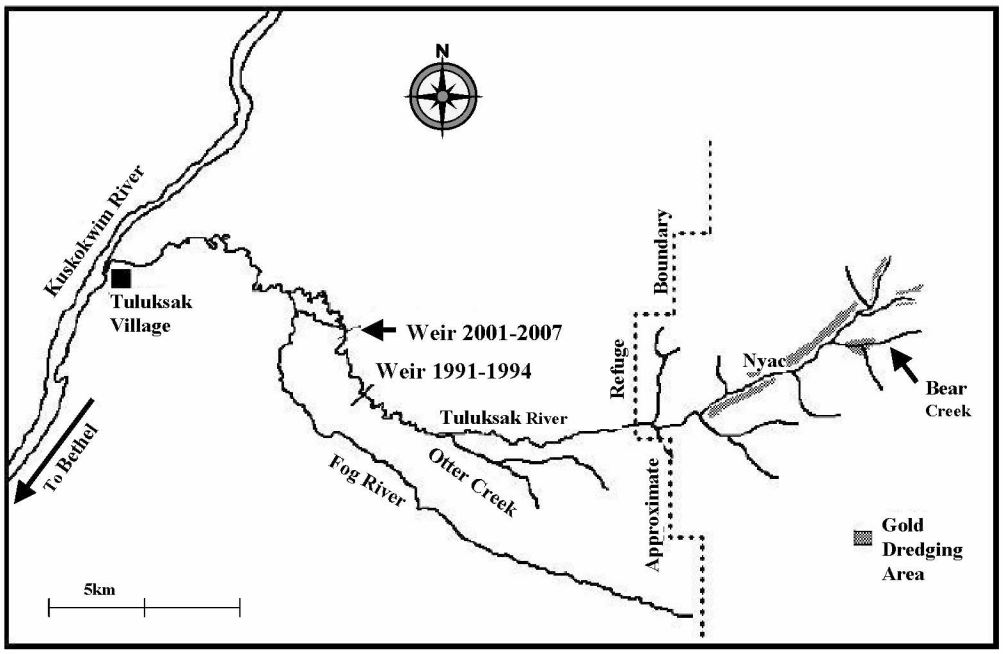

Figure 2. Tuluksak River weir locations prior to 1994 and after 2001. Otter Creek, Fog River, Nyac mine, and Refuge boundary are also shown (Plumb and Harper 2008).

Sampling timing and location. — Morphological characteristics of the Tuluksak River were obtained from aerial photographs, and printed and electronic maps. Locations of channel features and landmarks were collected from a USGS 1:63,000 map using All-Topo (iGage

Mapping Corporation) mapping software. In coordination with O'Brien (2006) the river was divided into six sections (Figure 3) between the USFWS refuge boundary and the 2001-2007 USFWS weir. Section boundaries were placed at locations where the channel differed in sinuosity or abruptly shifted direction. Aerial photographs were used to identify changes in cover types or configuration of gravel bars, and landmarks such as the Kilbuck Mountain foothills. This provides objective, geologically based divisions of the river into smaller units.

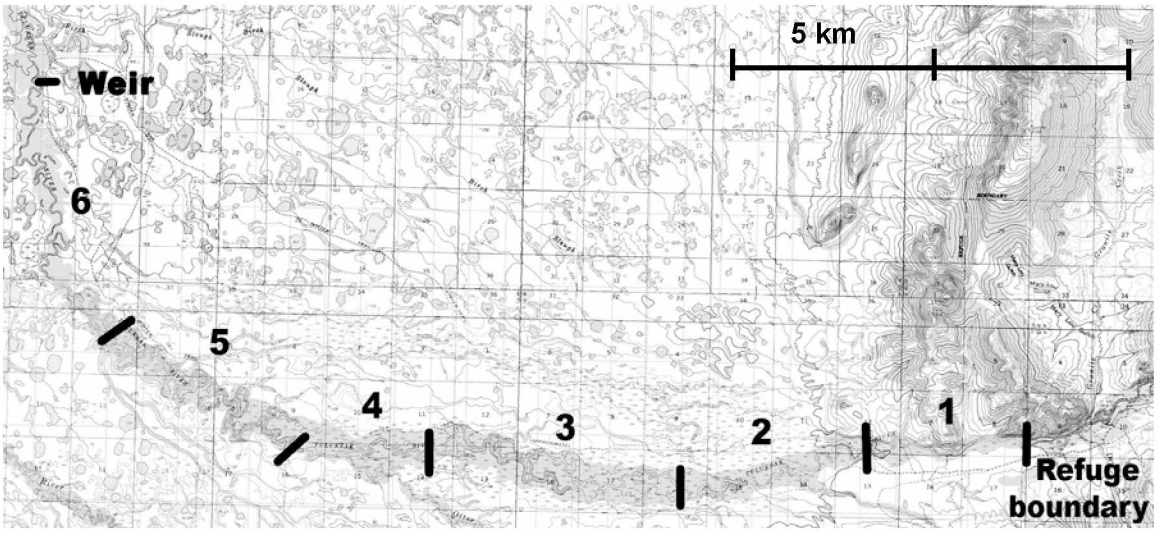

Figure 3. Map of the Tuluksak River sampling sections. Sections were numbered from the USFWS refuge boundary downstream to the weir, and were based on changes in channel morphology.

Sampling along the Tuluksak River was conducted via one boat trip and three raft trips. The boat sampling trip was discontinued in section three (Figure 3) due to shallow channels and difficulties of navigation. Sampling occurred as we traveled downstream and returned to the weir. Raft trips started below the Nyac mine (Table A1) just above the refuge boundary, and proceeded 75 rkm downstream to the weir. The 2002 boat trip took place from July 5 to July 10. The three raft trips were from July 30 to August 9 in 2002, and in 2003 on July 11 to July 19, and July 31 to August 6.

In 2002, sampling sites were chosen by a stratified random method. River section boundaries were used as a starting point where we rolled a 10 sided die, and used the result to determine how many x-tenths of a mile we would travel downstream within a section before sampling. After traveling the randomly determined distance, we then sampled every mile (1.6 km) until the next section boundary was reached, and a new random starting distance was determined. Section boundary coordinates were obtained from All-Topo (iGage Mapping Corporation) software prior to field work and entered into our GPS unit. Distances were measured using the path tracking features of our GPS unit, and sampling took place at the nearest gravel bar where the raft or boat could be safely landed. Sections ranged in length from 7.0 rkm to 20.6 rkm within the 75.8 rkm of sampled river distance. Sampling sites within sections were between 50 m and 300 m in length and up to 3.2 rkm apart. Section 1 was sampled only once, due to the presence of black and brown bears. Section 6 was sampled every 2 miles, based on its homogeneous nature.

In 2003, sampling sites were selected based on previous salmon observations. During the first raft trip of 2003, temperature data loggers deployed the previous summer were recovered, and GPS waypoints were collected for river features and salmon observations (Table A-1a and A-1b). The second 2003 raft trip occurred in early August and sampled at 20 locations where more than five Chinook salmon had been observed during previous raft trips.

Coordinates of river features, salmon observations, study sites, camp sites, and other locations were noted in the field as waypoints with a Magellan Meridian Marine handheld GPS unit using the WGS-84 map datum (Table A-1a and A-1b). Each waypoint name and GPS coordinates were imported to All-Topo (iGage Mapping Corporation) mapping software and the trace function used to follow the river channel and calculate distance in kilometers (rkm) from the 0.0 rkm location of the 2001-2007 weir site. Our collected waypoints corresponded well to

course of the Tuluksak River on the USGS map. Where the two diverged, distances were traced along the path of the collected waypoints.

Salmon observations. — Chinook salmon were identified by their size and spawning coloration. Carcasses were identified to species when possible. Locations of salmon were noted with GPS waypoints, and behavior was characterized as traveling/holding, or spawning/potentially spawning. Traveling salmon were actively swimming as we observed them. Holding salmon remained in one location as we passed by, but based on the undisturbed appearance of the substrate, were not associated with a redd. Spawning or potentially spawning salmon were observed actively engaging in spawning or redd guarding behavior, holding near a disturbed patch of gravel, or holding as a pair or group in a potential spawning location.

Salmon observations were recorded as Chinook Counts (the total count of Chinook within that stratum), Chinook Sites (locations with Chinook presence), Spawning Counts (total count of Chinook observed engaging in spawning behavior) and Spawning Sites (incidences of Chinook spawning behavior). The breakdown of individuals and sites was constructed to compare presence/absence and overall count with habitat variables. The rationale was that a spawning site could have any number of Chinook present, in relation to the size of the run, but that a site with five Chinook was not necessarily better spawning habitat than a site with only two Chinook observed.

Habitat characterization. — Habitat sites were described with sketch maps, photographs, riparian vegetation types, observations of weather, and fish observations. Gradient, substrate, velocity, stream width, channel depth, and discharge measurements were collected from areas that could safely be waded. Sinuosity was calculated as the traced distance in river kilometers (rkm) along the channel between two linear distance points 1 km apart, starting at the weir site and proceeding upriver. Elevation above sea level was identified at locations along the

Tuluksak River where topographic lines crossed the river, and was measured along the valley over 92.8 rkm from the weir to Nugget Creek. We also gathered elevation readings from GPS units, but the measurements were highly variable, unreliable, and were not used.

Gradient was measured using a Sokkia E 3s level with 22x magnification mounted on a Topcon tripod and sighted off of a Crain Enterprises Inc. CR-16-T leveling rod. Sightings for elevation were made off of the leveling rod positioned as far up and downstream as was accessible on foot or visible from the tripod. The average distance from the tripod to leveling rod was 63 m upstream and downstream. Range to the leveling rod was measured with the Bushnell range finder in 2002, and with a Nikon Laser 400 8x20 laser range finder accurate to 0.5 m in 2003. Measurements of angle and elevation were taken from the Sokkia level. Gradient was calculated as the difference in height over the distance between the two sightings.

River width was measured with either a 60-m tape or Bushnell #20-0880 range finder accurate to the nearest even meter. The length of sites was limited by visibility and accessibility, and ranged from 50 m to 300 m. Widths were taken at three or more locations, and where necessary to place in-stream gravel bars or other features on sketch maps.

Discharge was calculated along one transect at each site in 2002 where wadeable. Water velocities were measured using a Flomate Marsh-McBirney Inc. model 2000 portable flowmeter in feet per second. The sensor was positioned at appropriate depths using a Marsh-McBirney wading rod measured to the nearest 1/10th of a foot. Velocities were measured at 20% below the surface in water depths less than two feet (0.61 m), and 20% and 80% depth below the water surface for water more than two feet (0.61 m) deep at cells based on the pace length of the surveyor. Due to the presence of side channels, islands, and small tributaries, not all discharge measurements were taken at full channel areas.

The flowmeter was unavailable in 2003, so stream velocity was measured along the thalweg using the floating orange method (Bain and Stevenson 1999) and repeated 3 times at each site. Float distance was measured with the Nikon range finder, and timed with a stopwatch. Stream widths and depths were collected using cords transecting the river marked at 1 meter intervals, with depths taken with a wading rod at each meter.

At fifteen sites along the Tuluksak River in 2002, a temperature data logger (Onset corporation HOBO data logger) was installed. Twelve were retrieved in 2003. The loggers recorded temperature in degrees Celsius every 5 hours (Table A-3), and the average of these readings was taken to determine average daily temperature. Loggers were installed in cases with waterproof gaskets, attached by cables to duckbill anchors or trees, and weighed down with heavy chain to record water temperature just above the substrate. The average water temperature between deployment in August and freezing in November was calculated; values ranged between 5.8° C and 6.6° C for nine temperature loggers with complete records. This average fall water temperature was used to determine which temperature range to use for calculating degree days (dd) needed to reach hatch and emergence of Chinook salmon. In Chinook salmon egg incubation experiments at 5° C, it took 101.5 days from fertilization to 50% hatch (dd = 507.5) and 191 days from fertilization to 50% emergence (dd = 955), at 8° C, development took 67.1 days to 50% hatch (dd = 536.8) and 115 days to 50% emergence (dd = 920) (Murray and McPhail 1988). The daily water temperatures were summed to determine how many degree days were available before freeze-up, and to predict emergence dates.

Substrate data was collected by visual estimates (video, photos or slides) in 2002 and by Wolman pebble count (Bain and Stevenson 1999) in 2003. Observations were taken along transects across stream widths where physically accessible. Visual estimates consisted of placing a 50 cm x 50 cm metal grid marked at 1 cm and 5 cm increments on the river bottom and then

viewing or recording it through a clear bottomed bucket at the water surface. Wolman pebble counts consisted of 100 samples taken at each site, and measured along the intermediate axis. Substrate was classified using the modified Wentworth sizes in Bain and Stevenson (1999) as the percentage of fines, gravel, pebble, cobble, and boulder visible within the grid. Samples were grouped into size classes to estimate their percentage of the substrate. Chinook salmon spawn in a wide range of substrates, ranging from 2.5 cm to 30.5 cm in diameter (Hanrahan et al. 2004). Suitable spawning substrates for the Tuluksak River were defined as the percentage of the sample comprised of pebble plus cobble (1.6 cm to 25.6 cm).

Data analysis. — Habitat measurements were not uniformly collected at each sampling site, due to limitations of water depth and availability of equipment. Time constraints prevented sampling at every Chinook salmon observation. To compensate for data misalignment, the river was divided into 39 strata. Strata one began at the weir, and encompassed 1.7 rkm traced along the river to the start of strata two, 1.0 km from the weir. Strata two encompassed the 3.4 rkm within the next 1.0 km. This was continued from the weir to the upper extent of sampling at our raft put-in site. The length of each strata equaled its sinuosity (S rkm/1.0 km). Sampling sites were assigned to their respective strata, and their habitat measurements were averaged if more than one site occurred within a stratum. To test the significance of the relationships, Chinook observations within each strata were paired with values for habitat and river features. Analysis consisted of selecting strata with habitat features for the independent variable and Chinook observation as the dependent variable. Not every strata contained a measurement from each habitat sampling method. Strata containing a habitat measurement, but no Chinook observations, were used, and Chinook were given a value of zero indicating that no Chinook were observed in that area (Figure 8). Values for the river features determined the range of independent variables, and number of Chinook counts or sites within that strata comprised the dependent variable set.

This analysis was also conducted with Chinook salmon density taken into account. The number of Chinook salmon observed divided by the length of the strata was used as the dependent variable for Chinook salmon density and Chinook salmon spawning density (Table 4). Habitat variables were also compared to river distance, with river distance as the independent variable. Regression statistics including R Square and p-value were generated using the Excel (Microsoft Corporation) data analysis regression tool for each pair of Chinook Counts or Sites and a habitat variable. Variables were tested using a significance level of 0.05.

To determine if the frequency of river features was heterogeneous between randomly chosen sites from 2002, and sites selected based on Chinook salmon observations in 2003, three variables that were common in both years - substrate, gradient, and sinuosity, were compared using contingency analysis with the chi-square statistic. Values for chi-square were calculated using Excel formulas (Microsoft Corporation 2003). Analysis was performed on data from the entire river, on data from the upper portion of the river where Chinook salmon spawning was observed, and also by comparing data taken from the lower river (sites < 43 rkm) to the upper river (sites > 43 rkm).

Results

Chinook salmon distribution was found to have a generally linear relationship with elevation and rkm; as they increased, Chinook salmon numbers and observations increased. Chinook salmon numbers were low in the 40 rkm of the river above the weir, and were greater in the upper 30 rkm near the refuge boundary. Of the Chinook salmon observed in 2003 (n=570), few (n=134) were seen between 0.0 rkm to 41.6 rkm upstream from the weir, and many more (n = 436) were observed in the upper portion of the river, 41.6 rkm to 73.2 rkm from the weir. Chinook salmon were generally seen as singles or groups of five or less, with a group of twenty Chinook salmon the largest number seen in one place. Between July 11 -19 in 2003, over 50% of

the Chinook salmon in the river during that time period were observed (n = 397, weir passage = 747).

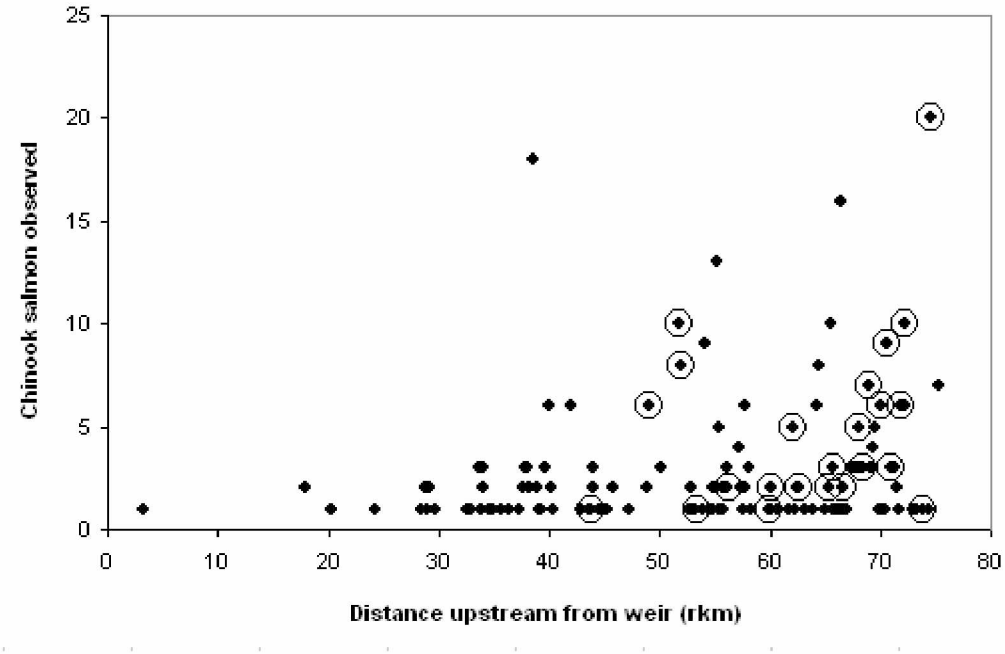

Figure 4. Chinook salmon observations and spawning behavior along the Tuluksak River. Circled points represent Chinook salmon observed in spawning related behavior.

Both the number of sites and number of Chinook salmon observed engaged in spawning behavior were greater in the upper river, with twenty Chinook salmon potentially spawning at 74.5 rkm, and ten Chinook salmon actively spawning 72.2 rkm upstream. During a brief tour of the Nyac mine area prior to our first raft trip in early July of 2003, we observed 5-10 Chinook salmon above the Nyac camp (over 80.0 rkm upstream from the weir). The farthest downriver location for spawning behavior was at 43.8 rkm above the Tuluksak weir (Figure 4). The greatest number of spawning sites were observed at an elevation of 84 m (n=7). Sites at 38 m were the lowest elevation for spawning (Figure 5).

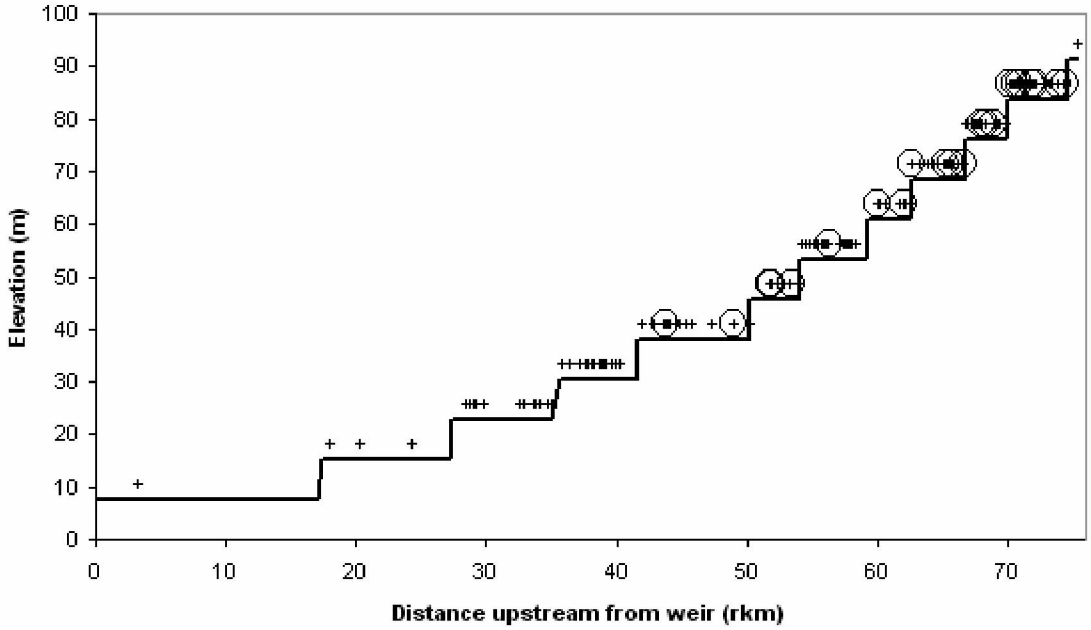

Figure 5. Elevation profile of the Tuluksak River with Chinook salmon observations. Points represent sightings of one or more Chinook salmon at each distance up-river and elevation of that river segment. Chinook salmon observed in spawning behavior are circled. The lowest elevation for spawning was 38.1 m above sea level

Other than shallow areas along the banks, no portion of the Tuluksak River was found to be outside of the depth range for spawning Chinook salmon. Channel depth ranged from 0.38 m to 2.29 m. Channel widths ranged from 14.0 m to 43.5 m, with an average mean width of 24.0 m. Only one sampling site had a velocity of 2.3 m/s, which is just above Chinook salmon spawning preferences for velocities between 0.25 m/s to 2.25 m/s. The rest of the thalweg velocities ranged between 0.7 m/s to 2.0 m/s. Water velocity along the banks, in slow moving side channels, back-waters, and eddies were lower than preferred velocities. River discharge increased downstream (Figure 6).

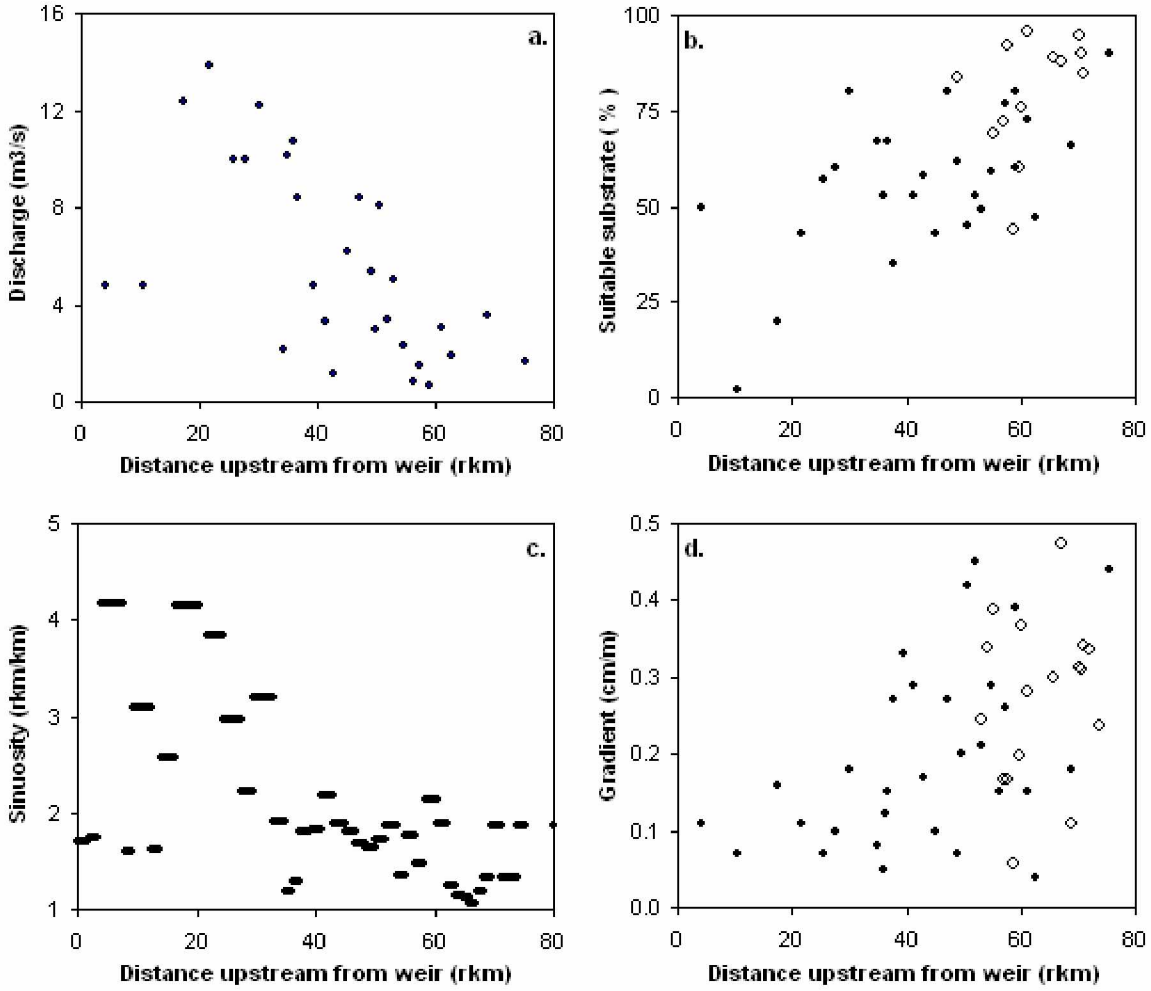

Figure 6. General physical characteristics of the Tuluksak River. (a) Discharge (m3/s) measured at randomly chosen sites in 2002. (b) Suitable substrate (the percentage of pebble and cobble observed) pooled from randomly chosen sites in 2002 (solid circles) and at Chinook salmon locations in 2003 (hollow circles). (c) Sinuosity estimated from map images. (d) Gradient pooled from randomly chosen sites in 2002 (solid circles) and at Chinook salmon observations in 2003 (hollow circles). Sampling sites are identified by their distance in river kilometers from the weir (0.0 rkm).

Gradient at sampling sites decreased in lower areas of the river (Figure 6). Gradient was measured at sites from 50 - 300 m in length and was highly variable. The largest gradient measure was from a site 67.19 rkm upstream from the weir which dropped 0.7 m over 150 m of river distance. The smallest gradient measure was from 62.5 rkm, with a drop of 0.04 m over 95

m of distance. The presence of channel features such as pools and riffles contribute to the variance in gradient values.

Sinuosity was highly variable in the lower 35 rkm of the Tuluksak River, ranging from 1.6 km to 4.2 km along the river for every kilometer of distance. In the upper portion of our study area from 35 rkm to 80 rkm above the weir, sinuosity varied between 1.07 rkm/km and 2.18 rkm/km (Figure 6).

Over 75% (31 out of 40) of sites sampled were comprised of more than 50% suitable substrate. These were predominantly found at sites over 25 rkm upstream from the weir. Sites in the lower 25 rkm of the Tuluksak River were more likely to have gravel and fines (0.0 cm to 1.5 cm) as their dominant substrate classes.

Temperature data was recovered from twelve data loggers (Table A-3). Of these, three did not record through the whole winter, or recorded temperatures dropping below minus 10 °C or above 16 °C indicating that the loggers were dewatered or faulty. Average daily temperatures exhibited for all loggers exhibited a sharp dip in temperature around October 21, 2002, followed by a warmer period, and then a drop to temperatures around 0 °C between November 10, 2002, and late April, 2003.

Temperatures records from the furthest upstream, downstream, and mid-river locations on the Tuluksak River show little difference in recorded temperatures (Figure 7). The other six loggers recorded very similar readings; in general, the data logger deployed 5.5 rkm upstream from the weir recorded the warmest temperatures, and the logger from a location 70.0 rkm upstream recorded colder temperatures. The largest variation in temperature occurred on May 1 of 2003, with a difference of 3.3 °C between the upper and lower river loggers.

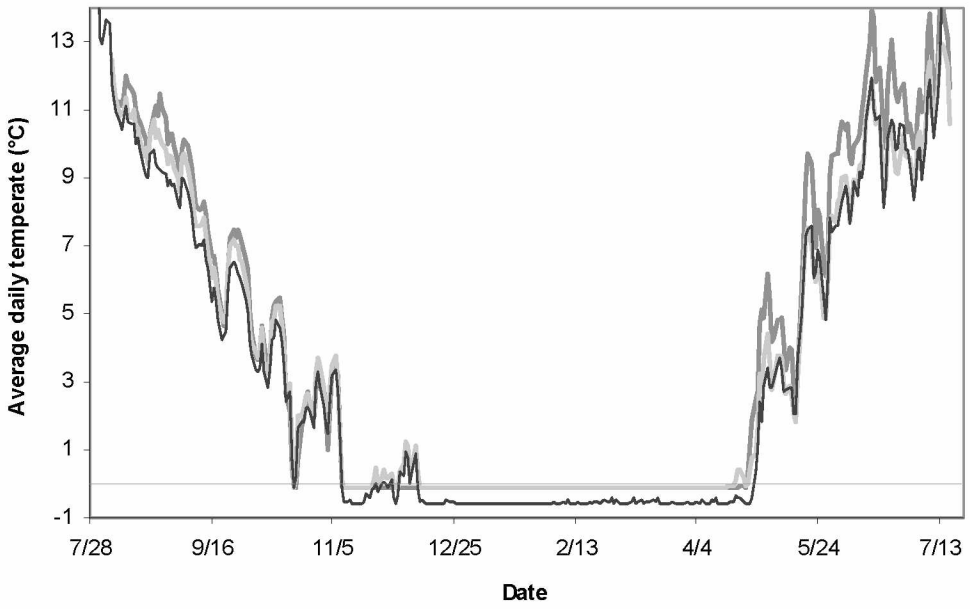

Figure 7. Average daily temperature (°C) from three locations of the Tuluksak River. Temperature loggers were located at 5.5 rkm upstream from the weir (black line), 44.1 rkm (white line), and 70.0 rkm (gray line). The start date is 7/28/02 and the end date for the series is 7/13/03.

Based on temperature data from the nine loggers with complete records, all locations along the river provided sufficient degree days for Chinook eggs to reach 536 degree days needed to hatch prior to freeze up in early November (Table 1).

Table 1. Results from nine temperature loggers. Degree dates (DD) for emergence are based on development time resulting in 50% emergence at 5 °C.

Logger location rkm	Average fall temperature °C	Average spring temperature °C	Elapsed DD before freezing	Emergence date at 950 DD
5.5	6.6	7.7	601.8	6/15
17.3	6.4	7.1	586.6	6/18
40.6	6.5	11.4	625.8	5/31
44.0	6.3	6.3	613.5	6/20
52.0	6.4	8.0	636.6	6/10
58.6	6.3	6.3	653.7	6/16
60.3	6.2	6.3	614.9	6/20
63.9	6.0	6.1	632.5	6/19
70.0	5.8	6.1	632.3	6/19

Predicted emergence dates range from May 31 to June 20; dates between the farthest upper and lower river loggers, dates for emergence are separated by four days. The logger from 40.6 rkm recorded temperatures above 2 °C on April 20 of 2003, 7-10 days earlier than the other temperature loggers.

Distance and elevation had a significant non-random relationship to all Chinook data (Table 2) at the 0.05 level. Suitable substrate was only significantly related to spawning sites. River distance was found to have a significant relationship with all the habitat variables with p-values of 0.001 or less for discharge, elevation, gradient, sinuosity, and suitable substrate.

Table 2. Chinook salmon observations from each strata compared to habitat variables and river features. A p-value less than 0.05 is indicated in bold text. An R^2 value closer to 1.0 indicates a better fit for the linear regression line.

Observations	Variable	n	R^2	P-value
Chinook sites	Discharge	29	0.10	0.100
	Distance	**46**	**0.22**	**0.000**
	Elevation	**46**	**0.19**	**0.002**
	Gradient	37	0.09	0.065
	Sinuosity	46	0.08	0.059
	Suitable substrate	35	0.10	0.068
	Thalweg velocity	35	0.01	0.068
Chinook counts	Discharge	**29**	**0.15**	**0.037**
	Distance	**46**	**0.30**	**0.000**
	Elevation	**46**	**0.31**	**0.000**
	Gradient	**37**	**0.19**	**0.007**
	Sinuosity	**46**	**0.16**	**0.006**
	Suitable substrate	35	0.07	0.118
	Thalweg velocity	15	0.01	0.741
Spawning sites	Discharge	29	0.04	0.289
	Distance	**46**	**0.26**	**0.000**
	Elevation	**46**	**0.28**	**0.000**
	Gradient	**37**	**0.14**	**0.024**
	Sinuosity	46	0.05	0.152
	Suitable substrate	**35**	**0.12**	**0.046**
	Thalweg velocity	15	0.04	0.503
Spawning counts	Discharge	8	0.27	0.190
	Distance	**17**	**0.24**	**0.023**
	Elevation	**17**	**0.29**	**0.026**
	Gradient	14	0.10	0.268
	Sinuosity	17	0.03	0.517
	Suitable substrate	14	0.07	0.371
	Thalweg velocity	11	0.16	0.217

The density of Chinook salmon (Chinook salmon per rkm) was significantly related to distance and elevation at the 0.05 level for Chinook salmon observations and spawning observation from the entire river, and from the upper portion of the river over 43 rkm upstream of the weir (Table 3).

Table 3. Density of Chinook salmon from strata compared to habitat variables. Chinook salmon observed in spawning behavior per river kilometer compared to habitat variables and river features. A p-value less than 0.05 is indicated in bold text. An R^2 value closer to 1.0 indicates a better fit for the linear regression line.

Observations	Variable	n	R^2	P-value
Chinook	Discharge	29	0.13	0.056
salmon	Distance	**46**	**0.29**	**0.000**
density	Elevation	**46**	**0.31**	**0.000**
	Gradient	**37**	**0.17**	**0.012**
	Sinuosity	**46**	**0.22**	**0.001**
	Suitable substrate	35	0.06	0.141
	Thalweg velocity	15	0.00	0.986
Chinook	Discharge	16	0.02	0.563
salmon	Distance	**28**	**0.22**	**0.011**
density:	Elevation	**28**	**0.22**	**0.012**
upper river	Gradient	24	0.05	0.281
	Sinuosity	**28**	**0.39**	**0.000**
	Suitable substrate	23	0.10	0.148
	Thalweg velocity	15	0.00	0.986
Spawning	Discharge	29	0.02	0.473
Chinook	Distance	**46**	**0.26**	**0.000**
salmon	Elevation	**46**	**0.31**	**0.000**
density	Gradient	**37**	**0.18**	**0.010**
	Sinuosity	46	0.08	0.061
	Suitable substrate	15	0.07	0.340
	Thalweg velocity	15	0.07	0.340
Spawning	Discharge	15	0.07	0.353
Chinook	Distance	**27**	**0.21**	**0.017**
salmon	Elevation	**27**	**0.19**	**0.023**
density:	Gradient	23	0.09	0.169
upper river	Sinuosity	27	0.05	0.241
	Suitable substrate	22	0.05	0.330
	Thalweg velocity	15	0.07	0.340

Contingency tables comparing data from randomly chosen sites in 2002 and sites selected based on the presence of Chinook salmon 2003 produced results significant at the 0.05 level for substrate when compared to random locations from the entire length of the river (Table 4). At the

0.10 level of significance, the frequency distribution of substrate was different between random and Chinook salmon locations in the upper portion of the river and was the only variable that came close to differentiating spawning sites from random sites within the upper river area. Sinuosity was significantly different between the upper and lower river, but not between random and Chinook salmon locations.

Table 4. Contingency table analysis results. Frequencies of observed river features from randomly chosen sites in 2002, and sites chosen at Chinook salmon locations from 2003 were compared. Analysis on the upper river was restricted to observations taken over 43 rkm upstream from the weir. Upper and lower river compared frequencies of observations from above and below 43 rkm.

	Variables	p-value	df	χ^2
Substrate	**2002 and 2003; entire river**	**0.01**	**2**	**10.13**
	2002 and 2003; upper river	0.10	2	4.69
	Upper and Lower river	0.38	2	1.95
Gradient	**2002 and 2003; entire river**	**0.04**	**4**	**10.06**
	2002 and 2003; upper river	0.31	2	2.36
	Upper and Lower river	0.33	2	2.24
Sinuosity	2002 and 2003; entire river	0.11	2	4.40
	2002 and 2003; upper river	0.45	6	5.74
	Upper and Lower river	**0.00**	**1**	**8.87**

Discussion

This study identified Chinook salmon spawning habitat as occurring in the portion of the Tuluksak River approximately 100 rkm from the mouth of the Tuluksak River, over 40 rkm upstream from the 2001-2007 weir site. The upper limit of spawning is outside the refuge boundary, within or beyond the Nyac mine area. Chinook salmon observations and spawning sites were observed more frequently in the upper portion of the river, and decreased downstream. The number of Chinook salmon observed increased towards the upper end of the study area, making it difficult to determine which percentage of the spawning areas were observed. Comparatively, chum salmon were observed between 35 rkm and 55 rkm (Figure 8). The lower boundary for potential salmon spawning of all species is suggested by the Tuluksak river weir.

Prior to 2001, the 1991-1994 weir camp was located 16 rkm further upstream. The weir was relocated to a site observed to be below spawning habitat for salmon populations by USFWS observations. No salmon were observed in spawning behavior below the weir (personal observations).

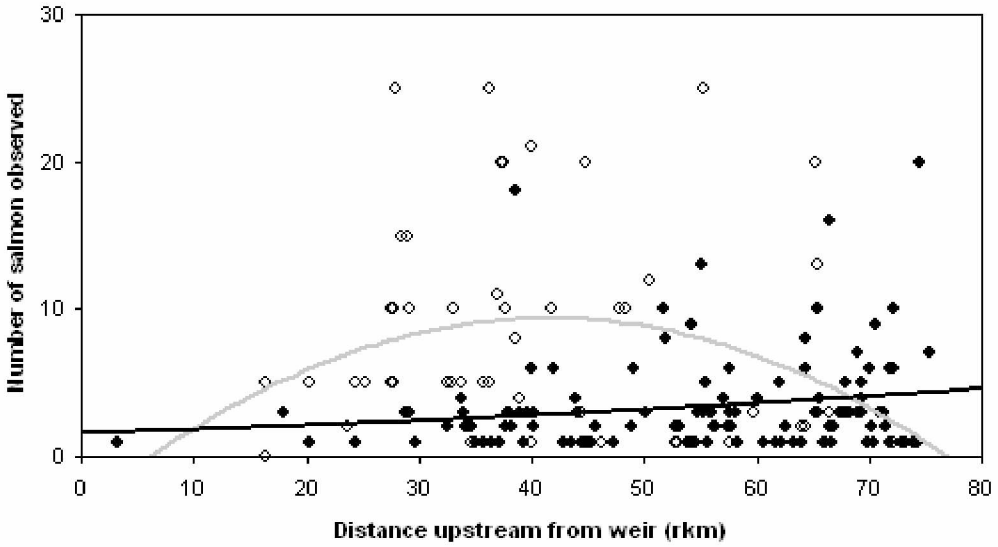

Figure 8. Comparison of salmon observations along the Tuluksak River. Chinook salmon (solid circles and black line) and chum salmon (hollow circles and gray line) observations were fitted with a second-order polynomial curve. Chum salmon distribution follows a dome shaped distribution, whereas Chinook salmon observations continue to trend upward at the edge of our study boundary.

Given the lack of escapement data past the refuge boundary or Nyac mine, it is difficult to say what percentage of Chinook salmon spawning habitat was observed. Increasing elevation and distance upstream correlated to all Chinook observations, and we did not find a maximum value for elevation or distance upstream within our study area above which Chinook salmon observations began to decrease. Chinook salmon spawning sites correlated to areas of more than 50% suitable substrate ($p = 0.046$); brief observations of the Tuluksak River channel above the Nyac mine also indicated areas of suitable substrate. Boulders appeared rare in the upper part of the river, and historical placer mining may have altered spawning substrate in the channel by sorting and removing fines and large boulders (Ripley et al. 1996, J. Durst, Alaska Department of

Fish and Game (ADF&G), personal communication). Habitat data lacked spatial resolution to determine which stream reaches or patches of gravel were suitable for spawning. We did not sample the lower 20 rkm of the river as frequently as upper areas, largely based on visual estimates indicating very uniform and unsuitable spawning habitat. Substrates in this portion of the river were primarily made up of small gravel and fine sediment. Pools accumulated sand and silt, as opposed to pools in the upper river, which had clear, uncovered, pebble and cobble bottoms. Sediment cores would be useful to compare the distribution of fines in the Tuluksak and Fog Rivers, and could shed light on the effects of past mining activity.

Many studies have been done attempting to describe and quantify spawning habitat (Chapman et al. 1986, Geist et al. 2000, Maclean 2003, Raleigh et al. 1986). Chinook salmon are large, powerful fish, and are capable at constructing redds in a wide variety of conditions. Spawning habitat for Chinook salmon has been studied in relation to water velocity (Geist et al. 2000, Raleigh et al. 1986), lateral slope (Geist et al. 2000), channel type, Froud number (Moir et al. 1998), subsurface flow (Vronskii and Leman 1991), substrate (DeVries 1997), scour (Montgomery et al. 1996, Rennie and Millar 2000), and others. However, there are no absolute correlations made between habitat aspects (depth, flow, etc) and spawning sites (Groot and Margolis, 1991). Geist et al (2000) described Chinook salmon spawning in water velocities of 0.5 to 2.0 m/s. Hanrahan et al (2004) found an even wider range of 0.25 m/s to 2.25 m/s. The habitat variables that were sampled during our field work were largely within spawning preferences of Chinook salmon for depth and water velocity. Only one of our sampling sites had a velocity measuring outside of Chinook salmon spawning preferences, however, habitat with suitable velocity was found nearby.

Chinook salmon often spawn in areas where water moves into and through the gravel, as opposed to chum, coho and sockeye salmon, which prefer to spawn in areas of underground

springs and upwelling (Vronskii and Leman 1991). Subsurface flow has been theorized to be the most important characteristic in determining spawning site selection, as good subsurface flow helps determine egg survival. Vronskiy (1972) observed most Chinook salmon redds as occurring at the head of a riffle. Vronskii and Leman (1991) described egg mortality in "typical places" at the tops of inclines as being 6%. Egg and larval mortality were low at the head of an incline, and would increase along with distance from the peak. Egg mortality in "atypical sites" such as in pools and riffles averaged 53% and 26% respectively in salmon studied on the upper Kamchatka River. These subsurface flow areas occur at the heads of riffles, pool tailouts, and where log jams or other obstructions drive water down through the substrate (Groot and Margolis 1991). Our gradient measurements were collected at sampling sites that included varying combinations of pools, riffles, runs, etc., and correlated poorly to Chinook salmon observations. Gradient measurements taken at pool tailouts, or fine scale measurements of subsurface flow from piezometers at pool tailouts would likely be more applicable to defining spawning sites. Peizometers were initially a part of the 2003 season sampling methods, but were soon abandoned; piezometer readings are variable within small areas (Maclean 2003), and installation is very time consuming. Piezometers could yield insight into subsurface flow patterns in the Tuluksak River, but they are more suited to a small scale study focusing on a short section of the river. Upper areas of the Tuluksak River exhibit numerous riffle-run-pool sequences and pool tailout sites (Table A-1b), and aside from beaver activity and the rare clearing of logs from the channel to aid navigation, woody debris in the Tuluksak River appeared to be in an undisturbed state (personal observations) increasing channel complexity.

Water temperature data collected from the Tuluksak River did not indicate a thermal boundary for egg development at any point along the study area. Chinook salmon egg development is largely determined by temperature. Warmer water allows metabolism to increase

and speed up the hatch process. Colder water slows development, but eggs spawned in cold water usually require fewer temperature units to hatch. Chinook salmon eggs reared at 8° C hatch at 67 days. However, at 2° C, eggs hatch at 202 days, which is less than the 308 days it would take if development took 4 times as long at colder temperatures (Murray and McPhail 1988). The temperature in the Tuluksak River dropped to near zero for five months out of the year. Based on Murray and McPhail (1988), emergence dates would be in mid-July. However, these calculations assumed that hatched Chinook experienced the measured temperatures. It is likely that Chinook salmon moved within the gravel to avoid temperatures of 0° C after hatching, and continued to develop throughout the period from November to late April before emerging. If hatched Chinook moved to areas with water temperature of 2° C, their emergence date could be in early March for all areas of the Tuluksak River.

Chinook salmon may not have settled on to redds and may have still been in the process of moving upstream during the sampling trips. Chinook salmon travel an estimated 7.0 km per day in the Kuskokwim River (Harper 1995c) and could travel above the upper extent of our study area within 11 days after passing the weir. Based on travel times and the 2003 weir passage counts, ten Chinook salmon could have traveled upstream beyond the study area by July 11, 2003, and 767 Chinook (72% of the total run) could have reached the raft put-in site 75 rkm from the weir before the start of our second raft trip of 2003 on July 31. At least 50% of the Chinook salmon run had entered the river during sampling trips in both years. Neilson and Banford (1983) observed Chinook salmon females spending up to 25 days at their redd sites in the Nechako River. Females arriving early in the season to spawn were found to remain at their redds about 14 days, with females later in the season remain in residence for only 5 days in the Nechako River in British Colombia (Groot and Margolis 1991). Females remain at the redd site for an additional 5 to 9 days after spawning to defend it from other females (Vronskiy 1972). No tagging or tracking

studies have been done within the Tuluksak River, so redd residence times and travel patterns for this population of Chinook salmon are unidentified. It is unknown if fish traveling farther upstream than the refuge boundary form a discrete and early portion of the run, or are evenly distributed throughout the spawning run period. There are many methods that could be utilized in further studies to determine redd residence times and the number of Chinook are traveling outside of the USFSW refuge such as tagging and observation, radio telemetry, or installing a fish counting station at the refuge boundary.

Aerial surveys of Chinook salmon escapement past the refuge boundary are sporadic and do not provide an estimate of the proportion of the run spawning below the Nyac mine (Table A-2). This reduces the ability to determine density of Chinook spawners per river kilometer or drainage area. Aerial surveys from ADF&G were occasionally carried out on upper areas of the Tuluksak River, however, surveys were not done every year, and surveys conducted in less than optimal conditions were not used for abundance estimates. While the numbers of Chinook salmon counted above the Nyac mine are not large, over 300 have been counted above the Nyac mine in a single year (1980), and most of the significant counts of Chinook salmon above the Nyac mine are from the 1980's (Figure 9). Francisco and Sundberg (1983) counted 34% of the observed run above the Nyac foothills. A distinctive rock face (Table A-1, WPT045) near the lower boundary of Section 1 of the study area at 65.9 rkm, is potentially the historical landmark used for the start of the foothills area. Unfortunately, complete aerial surveys of the area have not been carried out consistently, so it is difficult to know how usage of this habitat has changed over time, and even how many Chinook salmon currently travel above the Nyac mine to spawn.

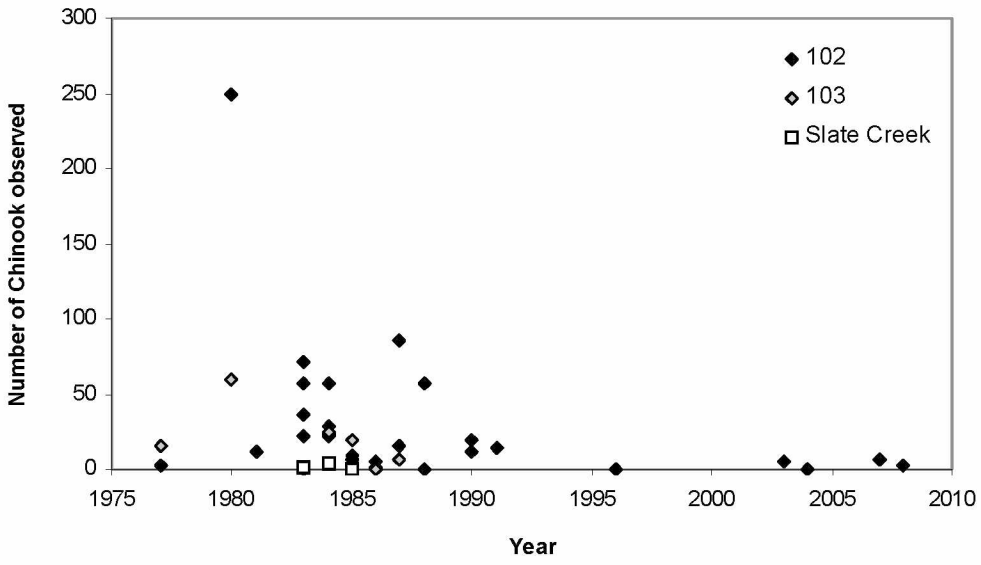

Figure 9. Historic observations of Chinook salmon above the Nyac mine. Raw data from aerial survey forms was provided by J. Linderman, ADF&G. Aerial survey notes from 1977 describe 101 as the area from the mouth to foothills, 102 as foothills to Nyac, and area 103 as above Nyac. Current area descriptions omit 103, and redefine 102 as starting above Nyac (see Figure 2). The redefinition of areas likely occurred in 1988 (Table A-2).

Further investigation on the Tuluksak River should take into account the extent gold mining activities have had on the biological integrity of the system. Placer gold mining operations have taken place on the Tuluksak River and many of its tributaries within the Kilbuck Mountains since 1908 (Calista Corporation 2000). Mining activities have shifted the channel for a portion of the upper Tuluksak River at least twice in the last 100 years from one side of the valley to the other and back. Water flow through Shamrock Creek) has been completely diverted, potentially blocking spawners and juveniles from previously used habitat (Figure 10). Dredging operations extract gold from alluvial sediments and use settling ponds to store water for operations and reduce sediment input to natural streams.

Figure 10. Mining activities on the Tuluksak River. Diversion of Shamrock Creek across mine tailings into the Tuluksak River (left). Abandoned dredge near raft put in site below tailings and Tuluksak River channel diversions (right). Photos taken by Jim Durst, ADF&G in 2005.

Mined areas that have been converted from vegetated forest to tailings may serve to dampen flooding by releasing water slowly from porous dredge tailings; local residents reported that flash floods were rare on the Tuluksak River (Hawley 1983). However, there has been no comparison of the pre-mining and current hydrology on the Tuluksak. The USFWS maintains water level gauges at its weir, but has only been in operation since 1991. Since at least the 1980's, dredging activities have been prohibited from crossing the Tuluksak River, and the Nyac mine has performed its operations by diverting a portion of the Tuluksak River through mining operations and then a series of settling ponds and channels before rejoining the river (C. Trowbridge, Nyac mine; J. Durst, ADF&G; L. Kerin, Alaska Department of Natural Resources, personal communication). Francisco and Sundberg (1983) noted mud and sand bars below the 1983 dredge crossing; this location potentially corresponds to the raft put-in site (Table A-1a, Table A-1b). The dredge (Figure 10, right) produced large amounts of sediment during its activities and was abandoned on the north bank of the Tuluksak River after an unauthorized crossing (Hawley 1983, C. Trowbridge, Nyac mine, and J. Durst, ADF&G, personal

communication). During sampling in 2002 and 2003, mud and sand bars were not observed in this area of the river, indicating that sediment previously in the area has since moved some distance downstream. We found that walking along the substrate did not release fine particles into the water column, other than in lower, slow moving areas of the Tuluksak River (personal observations). A comparison of the Fog and Tuluksak Rivers above their confluence using an Index of Biotic Integrity (Karr 1981) scoring could shed light on the effects of past mining activities.

This study focused on adult Chinook salmon and their spawning habitat. Competition from juvenile salmon of other species may affect Chinook salmon, however, this study did not quantify or evaluate habitat from a juvenile salmon's perspective or quantify juvenile food sources. More study of subgravel flow, temperature, substrate composition and sedimentation might shed light on egg survival rates and the true suitability of spawning habitat as measured by egg survival.

It is unlikely that the availability of spawning habitat limits productivity of this population. It is unknown if the Chinook salmon population was significantly larger in the 1800's, prior to mining. However, it is important to note that a steady population of Chinook salmon continues to be produced by the Tuluksak River. The Board of Fish has established a Biological Escapement Goal (BEG) of 1,000-2,100 for Chinook salmon entering the Tuluksak River (Linderman and Rearden 2007). Prior to 2007, the Tuluksak did not have the level of data needed to calculate BEG. ADF&G uses rivers with sufficient information for harvest and age data, and escapement from a sufficient period of time to build brood tables to establish BEGs (Brannian et al. 2006). Factors such as carrying capacity, habitat availability, historic stock levels, etc. are not used to determine BEG, and they are primarily based on calculations from recent escapements. To obtain a BEG, ADF&G identifies a range of spawners that have been

shown to produce the maximum sustainable yield (MSY), or could credibly produce MSY, and the BEG is calculated as 90% of those spawners. ADF&G currently uses escapement numbers from the Tuluksak River to calculate habitat-based escapement models for the Fog River (K. Schaberg, ADF&G, personal communication). While current habitat based models use the entire drainage area (Molyneaux and Brannian 2006), comparing drainage areas above 38 m in elevation or sinuosity less than 2.1 rkm/km could yield more accurate estimates for the Tuluksak River and similar rivers. Based on the finding from this study, Chinook salmon spawning should be found in the upper half of the length of the Fog River between its headwaters in the Kilbuck Mountains and where it drains into the Tuluksak River (Figure 11).

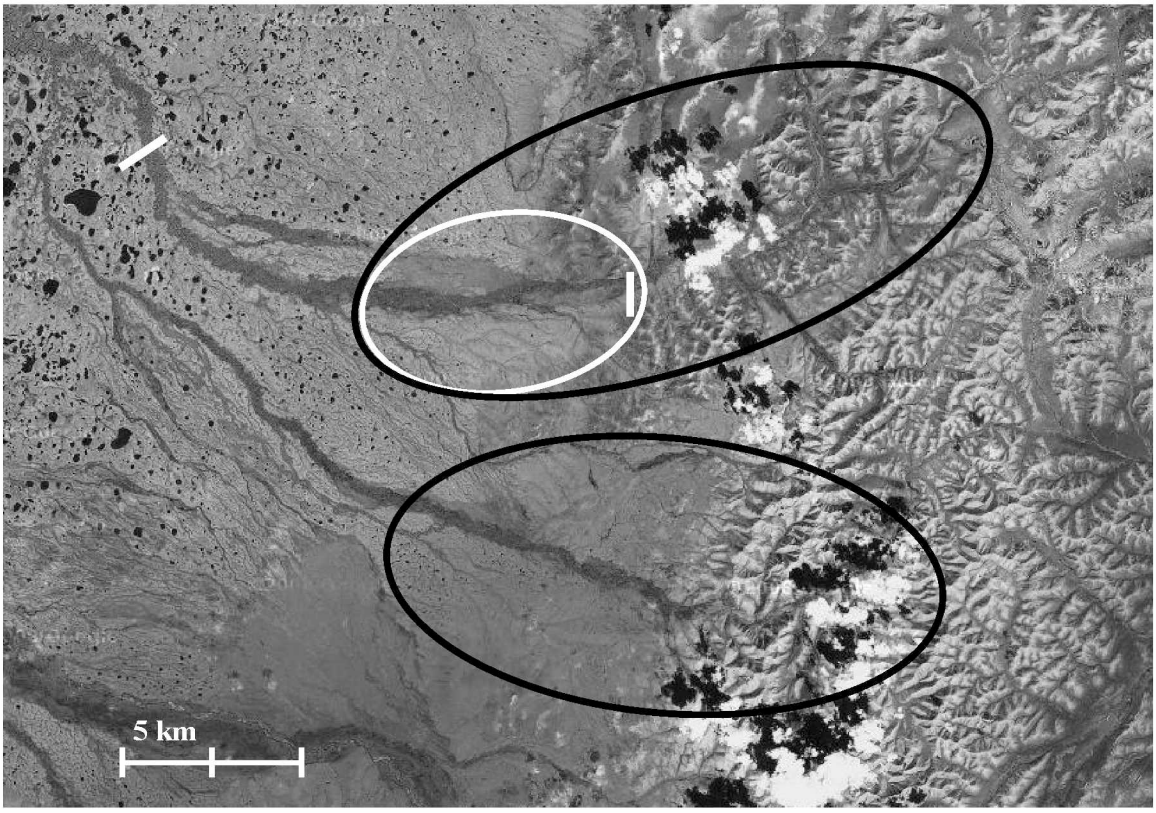

Figure 11. Tuluksak River drainage with observed and potential spawning areas. The white lines represent the weir and refuge boundary on the Tuluksak River. Chinook salmon spawning was observed within the white circled area. Black circled areas represent potential spawning areas on the Tuluksak and Fog Rivers.

It is potentially useful to find that the habitat variables which correlated best to Chinook salmon spawning observations in this study were large scale measurements of distance and elevation, which would be easy to obtain from maps and remote imaging, as opposed to fine scale habitat characteristics requiring intensive fieldwork. The structure of the Tuluksak River is organized with large sections of the upper river exhibiting similar riffle-run-pool and gravel bar/pool patterns that could be easily identified from remote images or photographs of good quality. Selecting several of these habitat elements and quantifying their associated substrate and subgravel flow could produce estimates of spawning habitat patch sizes per channel feature; multiplying that patch size by the number of features within the upper Tuluksak River could give an estimate of spawning area available to Chinook salmon. Similarly, the lower Tuluksak River contained fairly uniformly poor spawning habitat for Chinook salmon, which could also be identified from remote images.

While quantifying usable habitat as a basis for more biologically based escapement goals is a worthy endeavor, there are aspects of the Tuluksak River which work against using it as a proxy for other streams. An unknown portion of Chinook salmon spawning habitat lies outside of the USFWS refuge and in an area which has experienced mining activities for over 100 years. The inability to establish an upper boundary for spawning comparable to other river systems in the area should be taken into consideration when using the Tuluksak River as a baseline system for other streams in southwest Alaska. Without an upper limit for spawning, or knowing the numbers of Chinook salmon traveling above the refuge boundary, calculating spawner densities or productivity per unit area of the Tuluksak River will be difficult.

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Table A-1a. Noted points and sampling locations along the Tuluksak River. Coordinates use the WGS-84 datum. Distances from the weir to waypoints was traced from topographic maps. Noted points without coordinates were measured by tracing along the river course, and were not observed in the field. 'X sinuosity' markers were used to find a 1.0 km straight line along the river valley and then trace the river length between those points to get river sinuosity (rkm/km). Sinuosity markers were also used to define strata used in regression analysis. Substrate composition was estimated visually or by Wolman pebble counts.

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
TULWIER	07/19/03	N61°02'39.54"	W160°35'03.24"	0.00	1.7					
Section 6 start. Weir is 0 rkm for all referenced points				0.00	1.7					
1 sinuosity				1.70	1.7					
WPT399	07/19/03	N61°01'45.78"	W160°35'38.16"	3.18	1.7					
2 sinuosity				3.44	1.7					
6E	08/09/02	N61°01'37.80"	W160°35'24.80"	4.22	4.2	2	48	50	0	0
6EHOBO		N61°01'37.80"	W160°35'24.80"	4.22	4.2					
3 sinuosity				7.62	4.2					
4 sinuosity				9.22	1.6					
6C	08/09/02	N61°00'32.80"	W160°34'34.80"	10.52	3.1	90	8	2	0	0
5 sinuosity				12.31	3.1					
6 sinuosity				13.93	1.6					
WPT398	07/19/03	N60°59'22.14"	W160°33'29.70"	16.14	2.6					
WPT397	07/19/03	N60°59'22.44"	W160°33'26.22"	16.20	2.6					
WPT396	07/19/03	N60°59'20.58"	W160°33'25.62"	16.27	2.6					
WPT395	07/19/03	N60°59'18.72"	W160°33'25.86"	16.33	2.6					
WPT394	07/19/03	N60°59'17.82"	W160°33'24.24"	16.39	2.6					
WPT393	07/19/03	N60°59'17.10"	W160°33'23.28"	16.43	2.6					
WPT392	07/19/03	N60°59'15.84"	W160°33'23.16"	16.47	2.6					
7 sinuosity				16.50	2.6					
WPT391	07/19/03	N60°59'14.64"	W160°33'20.22"	16.55	4.1					
WPT390	07/19/03	N60°59'13.68"	W160°33'16.74"	16.65	4.1					
WPT389	07/19/03	N60°59'13.98"	W160°33'13.32"	16.76	4.1					
WPT388	07/19/03	N60°59'14.16"	W160°33'11.46"	16.79	4.1					
WPT387	07/19/03	N60°59'15.06"	W160°33'07.98"	16.86	4.1					
WPT386	07/19/03	N60°59'16.62"	W160°33'06.72"	16.92	4.1					
WPT385	07/19/03	N60°59'18.42"	W160°33'07.56"	16.99	4.1					
WPT384	07/19/03	N60°59'18.96"	W160°33'08.58"	17.02	4.1					
6HAB	08/09/02	N60°59'24.90"	W160°33'23.90"	17.33	4.1	37	43	20	0	0
6HABHOBO	08/09/02	N60°59'24.90"	W160°33'23.90"	17.33	4.1					
WPT383	07/19/03	N60°59'26.34"	W160°33'33.18"	17.53	4.1					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT382	07/19/03	N60°59'27.00"	W160°33'11.10"	17.89	4.1					
WPT381	07/19/03	N60°59'02.70"	W160°32'55.32"	20.21	4.1					
8 sinuosity				20.64	4.1					
Section 5 start. Section 6 end										
5I	08/08/02	N60°58'49.20"	W160°32'42.30"	21.70	3.8	30	27	43	0	0
WPT380	07/19/03	N60°58'53.46"	W160°31'56.34"	23.61	3.8					
WPT379	07/19/03	N60°58'54.72"	W160°31'53.70"	23.68	3.8					
WPT378	07/19/03	N60°58'56.22"	W160°31'52.86"	23.74	3.8					
WPT377	07/19/03	N60°58'57.24"	W160°31'51.60"	23.79	3.8					
WPT376	07/19/03	N60°58'57.78"	W160°31'49.38"	23.84	3.8					
WPT375	07/19/03	N60°58'56.70"	W160°31'45.60"	23.92	3.8					
WPT374	07/19/03	N60°58'54.96"	W160°31'40.98"	24.05	3.8					
WPT373	07/19/03	N60°58'54.00"	W160°31'36.48"	24.14	3.8					
WPT372	07/19/03	N60°58'52.68"	W160°31'34.86"	24.20	3.8					
WPT371	07/19/03	N60°58'51.06"	W160°31'36.78"	24.28	3.8					
WPT370	07/19/03	N60°58'51.24"	W160°31'40.92"	24.34	3.8					
WPT369	07/19/03	N60°58'51.54"	W160°31'42.54"	24.38	3.8					
WPT368	07/19/03	N60°58'51.60"	W160°31'45.24"	24.43	3.8					
9 sinuosity				24.48	3.8					
WPT367	07/19/03	N60°58'51.06"	W160°31'48.66"	24.48	3.0					
WPT366	07/19/03	N60°58'50.10"	W160°31'50.34"	24.54	3.0					
WPT365	07/19/03	N60°58'47.88"	W160°31'51.72"	24.63	3.0					
WPT364	07/19/03	N60°58'46.38"	W160°31'50.82"	24.67	3.0					
WPT363	07/19/03	N60°58'45.84"	W160°31'48.24"	24.73	3.0					
WPT362	07/19/03	N60°58'46.50"	W160°31'41.76"	24.85	3.0					
WPT361	07/19/03	N60°58'47.58"	W160°31'39.18"	24.92	3.0					
WPT360	07/19/03	N60°58'48.42"	W160°31'35.82"	24.99	3.0					
WPT359	07/19/03	N60°58'45.36"	W160°31'28.08"	25.18	3.0					
5G	08/08/02	N60°58'35.10"	W160°31'25.30"	25.67	3.0	10	33	57	0	0
WPT358	07/19/03	N60°58'28.44"	W160°31'31.86"	25.85	3.0					
WPT357	07/19/03	N60°58'27.36"	W160°31'32.46"	25.87	3.0					
WPT356	07/19/03	N60°58'26.88"	W160°31'31.92"	25.90	3.0					
WPT355	07/19/03	N60°58'26.52"	W160°31'30.30"	25.92	3.0					
WPT354	07/19/03	N60°58'27.24"	W160°31'27.66"	26.00	3.0					
WPT353	07/19/03	N60°58'28.32"	W160°31'25.20"	26.07	3.0					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT352	07/19/03	N60°58'28.62"	W160°31'22.74"	26.11	3.0					
WPT351	07/19/03	N60°58'28.56"	W160°31'17.52"	26.17	3.0					
WPT350	07/19/03	N60°58'28.02"	W160°31'13.86"	26.26	3.0					
WPT348	07/19/03	N60°58'29.70"	W160°31'12.06"	26.31	3.0					
WPT349	07/19/03	N60°58'28.74"	W160°31'12.00"	26.31	3.0					
WPT346	07/19/03	N60°58'33.12"	W160°31'12.24"	26.41	3.0					
WPT347	07/19/03	N60°58'31.44"	W160°31'12.30"	26.41	3.0					
WPT345	07/19/03	N60°58'33.84"	W160°31'11.22"	26.49	3.0					
WPT344	07/19/03	N60°58'32.22"	W160°30'46.14"	26.94	3.0					
WPT343	07/19/03	N60°58'34.68"	W160°30'46.74"	27.02	3.0					
WPT342	07/19/03	N60°58'38.16"	W160°30'46.56"	27.13	3.0					
WPT341	07/19/03	N60°58'42.00"	W160°30'41.94"	27.30	3.0					
WPT340	07/19/03	N60°58'43.02"	W160°30'37.80"	27.40	3.0					
10 sinuosity				27.45	3.0					
WPT339	07/19/03	N60°58'42.72"	W160°30'31.68"	27.52	2.2					
WPT338	07/19/03	N60°58'42.00"	W160°30'35.04"	27.59	2.2					
WPT337	07/19/03	N60°58'39.18"	W160°30'35.22"	27.70	2.2					
5E	08/08/02	N60°58'40.70"	W160°30'25.80"	27.74	2.2	23	17	60	0	0
WPT336	07/19/03	N60°58'35.64"	W160°30'31.50"	27.86	2.2					
WPT335	07/19/03	N60°58'37.56"	W160°30'23.70"	28.03	2.2					
WPT334	07/19/03	N60°58'35.22"	W160°30'10.08"	28.40	2.2					
WPT333	07/19/03	N60°58'35.34"	W160°30'12.90"	28.46	2.2					
WPT332	07/19/03	N60°58'29.40"	W160°30'14.22"	28.77	2.2					
WPT331	07/19/03	N60°58'28.92"	W160°30'03.54"	28.97	2.2					
WPT330	07/19/03	N60°58'29.64"	W160°30'01.98"	29.03	2.2					
WPT329	07/19/03	N60°58'29.76"	W160°29'53.22"	29.18	2.2					
11 sinuosity				29.68	2.2					
WPT328	07/19/03	N60°58'22.62"	W160°29'37.62"	29.74	3.2					
5C	08/08/02	N60°58'17.00"	W160°29'17.10"	30.18	3.2	0	20	80	0	0
WPT327	07/19/03	N60°58'12.18"	W160°29'25.86"	30.25	3.2					
WPT326	07/19/03	N60°58'13.14"	W160°28'56.52"	32.61	3.2					
WPT325	07/19/03	N60°58'10.80"	W160°28'47.94"	32.80	3.2					
WPT324	07/19/03	N60°58'10.44"	W160°28'44.04"	32.87	3.2					
12 sinuosity				32.88	3.2					
WPT323	07/19/03	N60°58'07.50"	W160°28'41.22"	33.00	1.9					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT322	07/19/03	N60°58'05.34"	W160°28'44.94"	33.11	1.9					
WPT321	07/19/03	N60°57'58.20"	W160°28'41.40"	33.41	1.9					
WPT320	07/19/03	N60°57'58.56"	W160°28'37.92"	33.48	1.9					
WPT319	07/19/03	N60°57'57.42"	W160°28'32.88"	33.57	1.9					
WPT318	07/19/03	N60°57'59.82"	W160°28'27.42"	33.70	1.9					
WPT317	07/19/03	N60°57'58.74"	W160°28'22.62"	33.81	1.9					
WPT316	07/19/03	N60°57'54.90"	W160°28'30.84"	34.03	1.9					
WPT315	07/19/03	N60°57'53.46"	W160°28'33.60"	34.10	1.9					
5HAB		N60°57'53.30"	W160°28'19.90"	34.24	1.9					
5HABHOB	07/09/02	N60°57'53.30"	W160°28'19.90"	34.24	1.9					
WPT314	07/19/03	N60°57'50.34"	W160°28'29.88"	34.26	1.9					
WPT313	07/19/03	N60°57'55.02"	W160°28'10.74"	34.64	1.9					
Section 5 end. Start Section 4										
WPT312	07/19/03	N60°57'53.94"	W160°28'05.88"	34.73	1.9					
13 sinuosity				34.80	1.9					
WPT311	07/19/03	N60°57'47.76"	W160°28'10.26"	35.01	1.2					
4D	08/07/02	N60°57'48.20"	W160°27'17.30"	35.07	1.2	3	23	67	7	0
WPT310	07/19/03	N60°57'46.32"	W160°28'09.54"	35.07	1.2					
ELEVATION100		N60°57'46.80"	W160°27'30.46"	35.60	1.2					
WPT309	07/19/03	N60°57'45.48"	W160°27'35.52"	35.71	1.2					
4C	08/07/02	N60°57'47.50"	W160°28'13.50"	35.84	1.2	17	30	53	0	0
WPT308	07/19/03	N60°57'47.88"	W160°27'30.12"	35.84	1.2					
14 sinuosity				35.98	1.2					
WPT307	07/19/03	N60°57'41.34"	W160°27'13.50"	36.23	1.3					
WPT306	07/19/03	N60°57'41.40"	W160°27'07.50"	36.34	1.3					
JGRDNT	08/06/03	N60°57'43.99"	W160°26' 57.01"	36.34	1.3					
WPT305	07/19/03	N60°57'41.28"	W160°27'04.08"	36.40	1.3					
WPT304	07/19/03	N60°57'40.98"	W160°26'58.02"	36.50	1.3					
4CMP3	07/08/02	N60°57'41.30"	W160°26'39.90"	36.73	1.3	10	10	67	12	0
4CMP3HOBO	07/08/02	N60°57'41.30"	W160°26'39.90"	36.73	1.3					
WPT303	07/19/03	N60°57'38.28"	W160°26'46.50"	36.73	1.3					
WPT302	07/19/03	N60°57'42.84"	W160°26'34.98"	37.02	1.3					
WPT301	07/19/03	N60°57'44.52"	W160°26'24.42"	37.21	1.3					
15 sinuosity				37.26	1.3					
WPT300	07/19/03	N60°57'43.98"	W160°26'19.50"	37.31	1.8					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT299	07/19/03	N60°57'45.24"	W160°26'13.02"	37.44	1.8					
WPT298	07/19/03	N60°57'46.56"	W160°26'03.66"	37.61	1.8					
WPT297	07/19/03	N60°57'43.62"	W160°26'01.86"	37.74	1.8					
4HAB	07/27/02	N60°57'45.30"	W160°25'52.10"	37.76	1.8	28	37	35	0	0
WPT296	07/19/03	N60°57'41.58"	W160°25'59.34"	37.83	1.8					
WPT295	07/19/03	N60°57'42.30"	W160°25'49.62"	38.03	1.8					
WPT294	07/19/03	N60°57'49.08"	W160°25'47.34"	38.26	1.8					
WPT293	07/19/03	N60°57'55.14"	W160°25'32.58"	38.62	1.8					
WPT292	07/19/03	N60°57'50.22"	W160°25'27.12"	38.91	1.8					
WPT291	07/19/03	N60°57'48.18"	W160°25'23.58"	39.01	1.8					
16 sinuosity				39.06	1.8					
WPT290	07/19/03	N60°57'47.94"	W160°25'12.36"	39.22	1.8					
4CMP2	07/07/02	N60°57'52.10"	W160°24'56.70"	39.34	1.8					
WPT289	07/18/03	N60°57'49.26"	W160°25'05.40"	39.37	1.8					
WPT288	07/18/03	N60°57'46.50"	W160°25'03.06"	39.48	1.8					
WPT287	07/18/03	N60°57'43.14"	W160°25'09.84"	39.66	1.8					
WPT286	07/18/03	N60°57'45.72"	W160°24'54.12"	39.98	1.8					
WPT285	07/18/03	N60°57'43.38"	W160°24'53.70"	40.08	1.8					
WPT284	07/18/03	N60°57'41.76"	W160°24'51.00"	40.17	1.8					
WPT283	07/18/03	N60°57'41.52"	W160°24'46.08"	40.25	1.8					
WPT282	07/18/03	N60°57'41.70"	W160°24'44.10"	40.28	1.8					
WPT281	07/18/03	N60°57'45.12"	W160°24'46.68"	40.41	1.8					
WPT280	07/18/03	N60°57'46.86"	W160°24'41.22"	40.54	1.8					
WPT279	07/18/03	N60°57'46.98"	W160°24'29.94"	40.72	1.8					
WPT278	07/18/03	N60°57'44.82"	W160°24'26.40"	40.83	1.8					
17 sinuosity				40.89	1.8					
WPT277	07/18/03	N60°57'43.02"	W160°24'27.36"	40.90	2.2					
WPT276	07/18/03	N60°57'41.76"	W160°24'24.72"	41.18	2.2					
4A	08/06/02	N60°57'45.50"	W160°24'13.00"	41.27	2.2	7	17	53	7	0
WPT275	07/18/03	N60°57'43.44"	W160°24'21.30"	41.27	2.2					
WPT274	07/18/03	N60°57'47.52"	W160°24'17.16"	41.44	2.2					
WPT273	07/18/03	N60°57'47.10"	W160°24'12.54"	41.54	2.2					
WPT272	07/18/03	N60°57'46.14"	W160°24'09.54"	41.61	2.2					
Section 4 end. Start Section 3										

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT271	07/18/03	N60°57'48.78"	W160°24'01.08"	41.80	2.2					
WPT270	07/18/03	N60°57'47.22"	W160°23'56.34"	41.91	2.2					
WPT269	07/18/03	N60°57'45.42"	W160°23'57.78"	41.96	2.2					
WPT268	07/18/03	N60°57'43.80"	W160°23'48.00"	42.20	2.2					
WPT267	07/18/03	N60°57'45.18"	W160°23'44.82"	42.29	2.2					
WPT266	07/18/03	N60°57'47.10"	W160°23'42.00"	42.38	2.2					
WPT265	07/18/03	N60°57'49.50"	W160°23'41.22"	42.47	2.2					
WPT264	07/18/03	N60°57'52.92"	W160°23'41.76"	42.59	2.2					
3G	08/06/02	N60°57'59.30"	W160°23'22.80"	42.80	2.2	5	37	58	0	0
3GHOBO	08/06/02	N60°57'59.30"	W160°23'22.80"	42.80	2.2					
WPT263	07/18/03	N60°57'56.52"	W160°23'34.08"	42.80	2.2					
WPT262	07/18/03	N60°57'56.64"	W160°23'29.64"	42.83	2.2					
WPT261	07/18/03	N60°57'59.34"	W160°23'27.66"	42.97	2.2					
WPT260	07/18/03	N60°58'01.38"	W160°23'27.72"	43.06	2.2					
18 sinuosity				43.07	2.2					
WPT259	07/18/03	N60°58'03.90"	W160°23'25.98"	43.16	1.9					
WPT258	07/18/03	N60°58'07.14"	W160°23'23.64"	43.30	1.9					
WPT257	07/18/03	N60°58'06.96"	W160°23'16.14"	43.38	1.9					
WPT256	07/18/03	N60°58'04.20"	W160°23'11.94"	43.55	1.9					
WPT255	07/18/03	N60°58'01.68"	W160°23'11.52"	43.64	1.9					
WPT254	07/18/03	N60°57'57.18"	W160°23'12.96"	43.81	1.9					
WPT253	07/18/03	N60°57'55.26"	W160°23'12.66"	43.88	1.9					
WPT252	07/18/03	N60°57'54.42"	W160°23'06.66"	43.98	1.9					
WPT251	07/18/03	N60°57'54.18"	W160°23'04.38"	44.03	1.9					
WPT250	07/18/03	N60°57'52.26"	W160°23'04.56"	44.11	1.9					
WPT249	07/18/03	N60°57'50.10"	W160°23'04.38"	44.17	1.9					
WPT248	07/18/03	N60°57'48.36"	W160°22'59.52"	44.30	1.9					
WPT247	07/18/03	N60°57'47.64"	W160°22'57.84"	44.35	1.9					
WPT246	07/18/03	N60°57'47.82"	W160°22'52.32"	44.43	1.9					
WPT245	07/18/03	N60°57'48.78"	W160°22'49.68"	44.51	1.9					
WPT244	07/18/03	N60°57'47.82"	W160°22'46.86"	44.58	1.9					
WPT243	07/18/03	N60°57'47.52"	W160°22'38.76"	44.74	1.9					
WPT242	07/18/03	N60°57'48.72"	W160°22'36.12"	44.81	1.9					
WPT241	07/18/03	N60°57'50.28"	W160°22'35.58"	44.88	1.9					
WPT240	07/18/03	N60°57'52.56"	W160°22'36.12"	44.94	1.9					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
19 sinuosity				44.96	1.9					
WPT239	07/18/03	N60°57'53.40"	W160°22'37.08"	44.99	1.8					
3F		N60°57'58.90"	W160°22'27.40"	45.10	1.8	7	50	43	0	0
WPT238	07/18/03	N60°57'56.22"	W160°22'37.14"	45.10	1.8					
WPT237	07/18/03	N60°57'56.16"	W160°22'32.70"	45.19	1.8					
WPT236	07/18/03	N60°57'55.62"	W160°22'30.48"	45.24	1.8					
WPT235	07/18/03	N60°57'55.68"	W160°22'28.38"	45.26	1.8					
WPT234	07/18/03	N60°57'56.10"	W160°22'27.06"	45.28	1.8					
WPT233	07/18/03	N60°57'54.90"	W160°22'23.88"	45.39	1.8					
WPT232	07/18/03	N60°57'50.10"	W160°22'24.36"	45.56	1.8					
WPT231	07/18/03	N60°57'48.66"	W160°22'26.34"	45.63	1.8					
WPT230	07/18/03	N60°57'46.20"	W160°22'25.86"	45.72	1.8					
WPT229	07/18/03	N60°57'45.12"	W160°22'21.60"	45.82	1.8					
WPT228	07/18/03	N60°57'45.72"	W160°22'17.52"	45.89	1.8					
WPT227	07/18/03	N60°57'43.62"	W160°22'11.46"	46.05	1.8					
WPT226	07/18/03	N60°57'41.70"	W160°22'08.88"	46.12	1.8					
WPT225	07/18/03	N60°57'40.50"	W160°22'03.54"	46.26	1.8					
WPT224	07/18/03	N60°57'41.22"	W160°22'00.48"	46.32	1.8					
WPT223	07/18/03	N60°57'42.30"	W160°21'57.78"	46.41	1.8					
WPT222	07/18/03	N60°57'42.84"	W160°21'52.38"	46.50	1.8					
WPT221	07/18/03	N60°57'42.00"	W160°21'48.24"	46.59	1.8					
WPT220	07/18/03	N60°57'40.38"	W160°21'44.16"	46.70	1.8					
WPT219	07/18/03	N60°57'40.92"	W160°21'42.24"	46.75	1.8					
20 sinuosity				46.77	1.8					
WPT218	07/18/03	N60°57'41.34"	W160°21'40.56"	46.78	1.7					
WPT217	07/18/03	N60°57'41.04"	W160°21'38.28"	46.84	1.7					
WPT216	07/18/03	N60°57'40.56"	W160°21'34.56"	46.89	1.7					
WPT215	07/18/03	N60°57'41.28"	W160°21'25.68"	47.06	1.7					
3E	08/05/02	N60°57'43.70"	W160°21'19.70"	47.07	1.7	5	15	80	0	0
WPT214	07/18/03	N60°57'36.12"	W160°21'19.86"	47.29	1.7					
WPT213	07/18/03	N60°57'35.10"	W160°21'19.62"	47.32	1.7					
WPT212	07/18/03	N60°57'34.08"	W160°21'19.14"	47.37	1.7					
WPT211	07/18/03	N60°57'32.22"	W160°21'18.84"	47.43	1.7					
WPT210	07/18/03	N60°57'31.50"	W160°21'19.68"	47.46	1.7					
WPT209	07/18/03	N60°57'31.14"	W160°21'20.76"	47.49	1.7					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT208	07/18/03	N60°57'30.60"	W160°21'21.78"	47.52	1.7					
WPT207	07/18/03	N60°57'29.94"	W160°21'22.02"	47.54	1.7					
WPT206	07/18/03	N60°57'26.94"	W160°21'20.22"	47.66	1.7					
WPT205	07/18/03	N60°57'26.22"	W160°21'18.60"	47.71	1.7					
WPT204	07/18/03	N60°57'26.22"	W160°21'16.56"	47.74	1.7					
WPT203	07/18/03	N60°57'25.44"	W160°21'12.06"	47.83	1.7					
WPT202	07/18/03	N60°57'25.56"	W160°21'10.32"	47.86	1.7					
WPT201	07/18/03	N60°57'25.38"	W160°21'06.72"	47.92	1.7					
WPT199	07/18/03	N60°57'23.28"	W160°21'05.46"	48.00	1.7					
WPT198	07/18/03	N60°57'22.74"	W160°21'03.60"	48.04	1.7					
WPT197	07/18/03	N60°57'22.74"	W160°21'02.34"	48.07	1.7					
WPT196	07/18/03	N60°57'23.16"	W160°21'00.42"	48.11	1.7					
WPT195	07/18/03	N60°57'23.40"	W160°20'59.04"	48.14	1.7					
WPT194	07/18/03	N60°57'24.00"	W160°20'57.72"	48.17	1.7					
WPT193	07/18/03	N60°57'24.30"	W160°20'56.46"	48.20	1.7					
WPT192	07/18/03	N60°57'24.42"	W160°20'55.86"	48.22	1.7					
WPT191	07/18/03	N60°57'24.48"	W160°20'55.20"	48.24	1.7					
WPT190	07/18/03	N60°57'24.48"	W160°20'53.58"	48.25	1.7					
WPT189	07/18/03	N60°57'24.60"	W160°20'52.38"	48.27	1.7					
WPT187	07/18/03	N60°57'25.92"	W160°20'51.06"	48.29	1.7					
WPT188	07/18/03	N60°57'25.02"	W160°20'51.18"	48.29	1.7					
WPT186	07/18/03	N60°57'26.70"	W160°20'51.84"	48.39	1.7					
WPT185	07/18/03	N60°57'27.12"	W160°20'54.00"	48.43	1.7					
21 sinuosity				48.44	1.7					
WPT184	07/18/03	N60°57'27.30"	W160°20'55.86"	48.47	1.6					
WPT183	07/18/03	N60°57'27.48"	W160°20'56.64"	48.48	1.6					
WPT182	07/18/03	N60°57'28.08"	W160°20'56.76"	48.51	1.6					
WPT181	07/18/03	N60°57'32.22"	W160°20'54.00"	48.68	1.6					
220	08/04/03	N60°57'31.46"	W160°20'33.79"	48.91	1.6	14	2	84	0	0
WPT180	07/18/03	N60°57'29.28"	W160°20'43.92"	48.91	1.6					
WPT179	07/18/03	N60°57'26.94"	W160°20'39.90"	49.03	1.6					
3D	08/05/02	N60°57'28.80"	W160°20'30.00"	49.05	1.6	22	17	62	0	0
WPT178	07/18/03	N60°57'25.44"	W160°20'38.82"	49.09	1.6					
WPT177	07/18/03	N60°57'21.84"	W160°20'35.22"	49.25	1.6					
WPT176	07/18/03	N60°57'19.62"	W160°20'40.68"	49.38	1.6					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT175	07/18/03	N60°57'18.00"	W160°20'38.46"	49.46	1.6					
WPT174	07/18/03	N60°57'17.40"	W160°20'35.94"	49.52	1.6					
WPT173	07/18/03	N60°57'14.04"	W160°20'35.16"	49.63	1.6					
3CAMP1	08/05/02	N60°57'16.20"	W160°20'23.30"	49.68	1.6					
WPT172	07/18/03	N60°57'13.32"	W160°20'32.58"	49.69	1.6					
WPT171	07/18/03	N60°57'13.68"	W160°20'26.46"	49.80	1.6					
WPT170	07/18/03	N60°57'15.24"	W160°20'22.44"	49.88	1.6					
WPT169	07/18/03	N60°57'18.12"	W160°20'23.40"	50.02	1.6					
22 sinuosity				50.09	1.6					
WPT168	07/18/03	N60°57'19.44"	W160°20'20.22"	50.11	1.7					
WPT167	07/18/03	N60°57'19.20"	W160°20'15.48"	50.19	1.7					
WPT166	07/18/03	N60°57'18.06"	W160°20'14.46"	50.23	1.7					
WPT165	07/18/03	N60°57'17.34"	W160°19'59.82"	50.49	1.7					
WPT164	07/18/03	N60°57'18.84"	W160°19'55.44"	50.59	1.7					
3C		N60°57'23.10"	W160°19'46.00"	50.67	1.7	11	11	45	33	0
3CHOBO	08/04/02	N60°57'23.10"	W160°19'46.00"	50.67	1.7					
3HI3	07/06/02	N60°57'23.10"	W160°19'46.00"	50.67	1.7					
WPT448		N60°57'27.11"	W160°19'39.97"	50.88	1.7					
WPT163	07/18/03	N60°57'25.92"	W160°19'47.94"	50.95	1.7					
WPT162	07/18/03	N60°57'24.24"	W160°19'39.06"	51.13	1.7					
WPT161	07/18/03	N60°57'26.04"	W160°19'35.40"	51.24	1.7					
WPT160	07/18/03	N60°57'17.76"	W160°18'13.98"	51.37	1.7					
WPT159	07/18/03	N60°57'17.76"	W160°18'13.98"	51.50	1.7					
WPT158	07/18/03	N60°57'17.76"	W160°18'13.98"	51.64	1.7					
WPT447		N60°57'23.65"	W160°19'09.84"	51.67	1.7					
WPT157	07/18/03	N60°57'17.76"	W160°18'13.98"	51.77	1.7					
WPT446		N60°57'24.30"	W160°19'03.94"	51.77	1.7					
23 sinuosity				51.82	1.7					
WPT445		N60°57'23.94"	W160°18'58.39"	51.85	1.9					
WPT156	07/18/03	N60°57'17.76"	W160°18'13.98"	51.90	1.9					
3HAB	08/04/02	N60°57'23.00"	W160°18'49.30"	52.02	1.9	23	17	53	7	0
WPT155	07/18/03	N60°57'17.76"	W160°18'13.98"	52.04	1.9					
WPT154	07/18/03	N60°57'17.76"	W160°18'13.98"	52.17	1.9					
WPT444		N60°57'19.22"	W160°18'39.17"	52.26	1.9					
WPT153	07/18/03	N60°57'17.76"	W160°18'13.98"	52.30	1.9					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT152	07/18/03	N60°57'19.80"	W160°18'42.48"	52.44	1.9					
WPT151	07/18/03	N60°57'22.74"	W160°18'44.22"	52.56	1.9					
WPT150	07/18/03	N60°57'24.78"	W160°18'47.10"	52.65	1.9					
WPT149	07/18/03	N60°57'27.18"	W160°18'47.58"	52.77	1.9					
WPT148	07/18/03	N60°57'28.08"	W160°18'49.38"	52.83	1.9					
WPT147	07/18/03	N60°57'30.54"	W160°18'48.42"	52.92	1.9					
3B	08/04/02	N60°57'32.30"	W160°18'34.70"	53.00	1.9	27	22	49	3	0
WPT145	07/18/03	N60°57'30.00"	W160°18'43.80"	53.00	1.9					
WPT146	07/18/03	N60°57'30.48"	W160°18'46.92"	53.00	1.9					
WPT144	07/18/03	N60°57'29.34"	W160°18'41.76"	53.05	1.9					
WPT143	07/18/03	N60°57'28.38"	W160°18'40.32"	53.10	1.9					
219	08/04/03	N60°57'29.45"	W160°18'24.80"	53.21	1.9					
WPT142	07/18/03	N60°57'27.42"	W160°18'34.86"	53.21	1.9					
WPT141	07/18/03	N60°57'30.84"	W160°18'32.88"	53.36	1.9					
WPT140	07/18/03	N60°57'30.36"	W160°18'27.66"	53.46	1.9					
WPT139	07/18/03	N60°57'31.08"	W160°18'21.18"	53.59	1.9					
24 sinuosity				53.69	1.9					
WPT138	07/18/03	N60°57'34.32"	W160°18'15.96"	53.85	1.4					
WPT137	07/18/03	N60°57'32.52"	W160°18'12.90"	53.95	1.4					
218	08/04/03	N60°57'33.44"	W160°17'57.80"	54.06	1.4					
WPT443		N60°57'33.41"	W160°17'58.06"	54.06	1.4					
WPT136	07/18/03	N60°57'31.08"	W160°18'07.14"	54.08	1.4					
ELEVATION175		N60°57'35.80"	W160°17'50.21"	54.10	1.4					
WPT135	07/18/03	N60°57'32.58"	W160°18'04.56"	54.15	1.4					
WPT134	07/18/03	N60°57'34.86"	W160°17'56.70"	54.35	1.4					
WPT133	07/18/03	N60°57'32.16"	W160°17'57.06"	54.45	1.4					
WPT132	07/18/03	N60°57'30.54"	W160°17'55.62"	54.52	1.4					
WPT131	07/18/03	N60°57'29.28"	W160°17'55.08"	54.56	1.4					
WPT130	07/18/03	N60°57'28.68"	W160°17'51.60"	54.63	1.4					
3A		N60°57'31.90"	W160°17'37.60"	54.71	1.4	13	12	59	17	0
3AHOBO	08/03/02	N60°57'31.90"	W160°17'37.60"	54.71	1.4					
WPT129	07/18/03	N60°57'29.10"	W160°17'46.02"	54.76	1.4					
WPT128	07/18/03	N60°57'29.28"	W160°17'44.22"	54.79	1.4					
WPT442		N60°57'33.91"	W160°17'28.28"	54.92	1.4					
WPT127	07/18/03	N60°57'33.12"	W160°17'36.06"	55.01	1.4					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
25 sinuosity				55.05	1.4					
WPT126	07/18/03	N60°57'32.82"	W160°17'32.16"	55.08	1.8					
WPT125	07/18/03	N60°57'31.44"	W160°17'29.64"	55.16	1.8					
217	08/04/03	N60°57'33.44"	W160°17'18.82"	55.17	1.8	18	13	69	0	0
WPT441		N60°57'33.77"	W160°17'18.78"	55.17	1.8					
WPT124	07/18/03	N60°57'29.88"	W160°17'27.24"	55.24	1.8					
WPT123	07/18/03	N60°57'28.32"	W160°17'25.14"	55.32	1.8					
WPT122	07/18/03	N60°57'26.64"	W160°17'22.44"	55.41	1.8					
Section 3 end. Start Section 2										
WPT121	07/18/03	N60°57'19.86"	W160°17'15.90"	55.68	1.8					
WPT120	07/18/03	N60°57'19.08"	W160°17'16.74"	55.70	1.8					
WPT119	07/18/03	N60°57'16.14"	W160°17'13.68"	55.82	1.8					
WPT118	07/18/03	N60°57'16.56"	W160°17'10.38"	55.88	1.8					
WPT117	07/18/03	N60°57'19.26"	W160°17'04.98"	56.03	1.8					
WPT116	07/18/03	N60°57'19.62"	W160°17'03.66"	56.06	1.8					
WPT115	07/18/03	N60°57'19.56"	W160°16'59.22"	56.15	1.8					
WPT114	07/18/03	N60°57'15.12"	W160°16'56.40"	56.31	1.8					
2DHOBO	08/03/02	N60°57'31.90"	W160°17'37.60"	56.34	1.8					
2D	08/03/02	N60°57'16.50"	W160°16'48.60"	56.30	2.1	3	10	80	7	0
WPT113	07/18/03	N60°57'09.96"	W160°16'54.36"	56.55	1.8					
26 sinuosity				56.82	1.8					
WPT112	07/18/03	N60°57'13.02"	W160°16'41.22"	56.83	1.5					
WPT111	07/18/03	N60°57'15.18"	W160°16'39.72"	56.92	1.5					
WPT110	07/18/03	N60°57'17.70"	W160°16'36.54"	57.04	1.5					
216	08/04/03	N60°57'21.46"	W160°16'25.82"	57.08	1.5	17	11	72	0	0
WPT440		N60°57'21.46"	W160°16'25.82"	57.08	1.5					
WPT109	07/18/03	N60°57'19.02"	W160°16'36.06"	57.09	1.5					
WPT108	07/18/03	N60°57'19.86"	W160°16'35.52"	57.14	1.5					
WPT107	07/18/03	N60°57'21.60"	W160°16'33.24"	57.22	1.5					
WPT439		N60°57'25.27"	W160°16'21.76"	57.28	1.5					
2HAB		N60°57'25.50"	W160°16'23.00"	57.32	1.5	0	17	77	7	0
2HHOBO	08/02/02	N60°57'25.50"	W160°16'23.00"	57.32	1.5					
GAR045		N60°57'27.00"	W160°16'22.01"	57.36	1.5					
WPT438		N60°57'26.68"	W160°16'19.74"	57.41	1.5					
WPT105	07/18/03	N60°57'24.18"	W160°16'28.62"	57.45	1.5					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT104	07/18/03	N60°57'24.84"	W160°16'25.74"	57.51	1.5					
WPT103	07/18/03	N60°57'23.34"	W160°16'23.52"	57.58	1.5					
215	08/04/03	N60°57'24.44"	W160°16'12.83"	57.63	1.5	5	3	92	0	0
WPT437		N60°57'24.48"	W160°16'13.08"	57.63	1.5					
WPT102	07/18/03	N60°57'21.42"	W160°16'24.06"	57.66	1.5					
WPT101	07/18/03	N60°57'20.28"	W160°16'24.18"	57.70	1.5					
WPT100	07/18/03	N60°57'19.50"	W160°16'24.06"	57.73	1.5					
WPT106	07/18/03	N60°57'19.62"	W160°16'23.94"	57.73	1.5					
GAR046		N60°57'16.99"	W160°16'16.00"	57.82	1.5					
WPT099	07/18/03	N60°57'19.02"	W160°16'18.42"	57.82	1.5					
WPT098	07/18/03	N60°57'18.66"	W160°16'01.74"	58.09	1.5					
WPT097	07/18/03	N60°57'20.16"	W160°15'55.26"	58.24	1.5					
WPT096	07/18/03	N60°57'21.72"	W160°15'55.02"	58.30	1.5					
27 sinuosity				58.31	1.5					
WPT095	07/18/03	N60°57'22.86"	W160°15'52.26"	58.37	2.1					
GAR038		N60°57'25.99"	W160°15'42.98"	58.40	2.1					
WPT094	07/18/03	N60°57'24.24"	W160°15'42.48"	58.71	2.1					
214	08/04/03	N60°57'26.46"	W160°15'26.82"	58.80	2.1	40	16	44	0	0
WPT436		N60°57'26.68"	W160°15'26.78"	58.80	2.1					
WPT093	07/18/03	N60°57'25.02"	W160°15'36.90"	58.83	2.1					
WPT092	07/18/03	N60°57'26.94"	W160°15'38.46"	58.91	2.1					
2C	08/02/02	N60°57'31.50"	W160°15'30.90"	58.99	2.1	10	23	60	7	0
2CHOBO	08/02/02	N60°57'31.50"	W160°15'30.90"	59.00	2.1					
WPT091	07/18/03	N60°57'29.34"	W160°15'37.92"	59.06	2.1					
WPT090	07/18/03	N60°57'30.06"	W160°15'26.88"	59.27	2.1					
WPT089	07/18/03	N60°57'31.02"	W160°15'20.16"	59.38	2.1					
WPT088	07/18/03	N60°57'28.92"	W160°15'09.24"	59.59	2.1					
WPT087	07/18/03	N60°57'25.98"	W160°15'02.88"	59.77	2.1					
213	08/04/03	N60°57'28.44"	W160°14'52.80"	59.78	2.1	30	10	60	0	0
WPT435		N60°57'28.33"	W160°14'53.27"	59.78	2.1					
WPT086	07/18/03	N60°57'22.44"	W160°15'00.96"	59.91	2.1					
WPT434		N60°57'24.48"	W160°14'49.49"	59.94	2.1					
WPT085	07/18/03	N60°57'21.48"	W160°14'59.64"	59.97	2.1					
WPT084	07/18/03	N60°57'21.00"	W160°14'55.56"	60.03	2.1					
WPT083	07/18/03	N60°57'21.90"	W160°14'50.76"	60.13	2.1					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
212	08/04/03	N60°57'25.45"	W160°14'38.80"	60.19	2.1	1	20	76	3	0
WPT433		N60°57'25.42"	W160°14'38.65"	60.19	2.1					
WPT432		N60°57'27.18"	W160°14'36.96"	60.27	2.1					
WPT082	07/18/03	N60°57'27.90"	W160°14'42.06"	60.43	2.1					
28 sinuosity				60.45	2.1					
WPT081	07/18/03	N60°57'30.54"	W160°14'37.32"	60.58	1.9					
WPT080	07/18/03	N60°57'33.36"	W160°14'36.48"	60.70	1.9					
WPT079	07/18/03	N60°57'33.90"	W160°14'30.66"	60.83	1.9					
210		N60°57'35.58"	W160°14'24.78"	61.06	1.9	0	2	96	2	0
CAMP1707	07/17/03	N60°57'35.58"	W160°14'24.78"	61.06	1.9					
2BHOB	07/17/03	N60°57'39.00"	W160°14'25.00"	61.17	1.9					
2B		N60°57'41.80"	W160°14'15.10"	61.18	1.9	0	20	73	7	0
WPT078	07/17/03	N60°57'39.00"	W160°14'24.48"	61.19	1.9					
WPT077	07/17/03	N60°57'40.32"	W160°14'15.66"	61.36	1.9					
WPT431		N60°57'43.77"	W160°14'03.01"	61.43	1.9					
WPT076	07/17/03	N60°57'39.18"	W160°14'10.02"	61.53	1.9					
WPT075	07/17/03	N60°57'36.36"	W160°13'59.04"	61.77	1.9					
WPT430		N60°57'38.66"	W160°13'49.33"	61.77	1.9					
WPT429		N60°57'50.83"	W160°12'52.38"	61.93	1.9					
WPT074	07/17/03	N60°57'36.84"	W160°13'43.92"	62.08	1.9					
WPT073	07/17/03	N60°57'36.48"	W160°13'40.92"	62.10	1.9					
WPT072	07/17/03	N60°57'36.36"	W160°13'33.18"	62.24	1.9					
WPT071	07/17/03	N60°57'36.36"	W160°13'30.96"	62.27	1.9					
29 sinuosity				62.33	1.9					
WPT070	07/17/03	N60°57'36.72"	W160°13'26.10"	62.35	1.2					
WPT428		N60°57'49.68"	W160°12'49.25"	62.37	1.2					
WPT069	07/17/03	N60°57'37.56"	W160°13'19.26"	62.50	1.2					
2AHOBO	07/17/03	N60°57'42.00"	W160°13'18.00"	62.65	1.2					
2A		N60°57'44.00"	W160°13'08.10"	62.65	1.2	0	13	47	23	17
WPT068	07/17/03	N60°57'40.56"	W160°13'23.04"	63.21	1.2					
WPT427		N60°57'47.95"	W160°12'42.91"	63.25	1.2					
WPT426		N60°57'48.35"	W160°12'38.92"	63.34	1.2					
WPT425		N60°57'50.72"	W160°12'36.54"	63.47	1.2					
WPT424		N60°57'56.34"	W160°11'52.66"	63.54	1.2					
30 sinuosity				63.57	1.2					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT423		N60°58'00.12"	W160°09'01.58"	63.65	1.1					
WPT067	07/17/03	N60°57'52.80"	W160°12'58.44"	63.93	1.1					
CAMP1507	07/15/03	N60°57'53.00"	W160°12'59.00"	63.94	1.1					
WPT060	07/17/03	N60°57'52.80"	W160°12'58.44"	63.94	1.1					
WPT061	07/17/03	N60°57'52.80"	W160°12'58.44"	63.94	1.1					
WPT062	07/17/03	N60°57'52.80"	W160°12'58.44"	63.94	1.1					
WPT063	07/17/03	N60°57'52.80"	W160°12'58.44"	63.94	1.1					
WPT064	07/17/03	N60°57'52.80"	W160°12'58.44"	63.94	1.1					
WPT065	07/17/03	N60°57'52.80"	W160°12'58.44"	63.94	1.1					
WPT066	07/17/03	N60°57'52.80"	W160°12'58.44"	63.94	1.1					
WPT059	07/15/03	N60°57'55.50"	W160°12'55.44"	64.04	1.1					
WPT058	07/15/03	N60°57'56.52"	W160°12'41.58"	64.28	1.1					
WPT057	07/15/03	N60°57'56.00"	W160°12'35.00"	64.38	1.1					
WPT056	07/15/03	N60°57'56.00"	W160°12'33.00"	64.42	1.1					
WPT055	07/15/03	N60°57'53.00"	W160°12'27.00"	64.59	1.1					
31 sinuosity				64.71	1.1					
WPT054	07/15/03	N60°57'49.00"	W160°12'26.00"	64.72	1.1					
WPT053	07/15/03	N60°57'48.00"	W160°12'28.00"	64.77	1.1					
WPT052	07/15/03	N60°57'45.00"	W160°12'25.00"	64.90	1.1					
WPT051	07/15/03	N60°57'45.00"	W160°12'18.00"	65.04	1.1					
CHMCABIN	07/15/03	N60°57'48.00"	W160°12'07.00"	65.27	1.1					
Section 2 End. Start Section 1										
WPT049	07/15/03	N60°57'50.00"	W160°12'05.00"	65.34	1.1					
WPT050	07/15/03	N60°57'46.00"	W160°12'12.00"	65.36	1.1					
WPT048	07/15/03	N60°57'53.00"	W160°12'04.00"	65.47	1.1					
WPT422		N60°58'00.37"	W160°09'00.61"	65.50	1.1					
209	08/02/03	N60°57'58.00"	W160°12'01.00"	65.64	1.1	6	4	89	1	0
WPT047	07/15/03	N60°57'58.00"	W160°12'01.00"	65.64	1.1					
WPT046	07/15/03	N60°58'00.00"	W160°11'55.00"	65.77	1.1					
32 sinuosity				65.83	1.1					
WPT045	07/15/03	N60°58'00.00"	W160°11'50.00"	65.87	1.1					
WPT044	07/15/03	N60°57'52.00"	W160°11'49.00"	66.21	1.1					
WPT043	07/15/03	N60°57'51.00"	W160°11'47.00"	66.27	1.1					
WPT042	07/15/03	N60°57'50.00"	W160°11'38.00"	66.44	1.1					
WPT041	07/15/03	N60°57'51.00"	W160°11'31.00"	66.57	1.1					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT040	07/15/03	N60°57'51.00"	W160°11'24.00"	66.68	1.1					
WPT039	07/15/03	N60°57'52.00"	W160°11'23.00"	66.73	1.1					
ELEVATION250		N60°57'55.71"	W160°11'11.51"	66.74	1.1					
WPT038	07/15/03	N60°57'54.00"	W160°11'19.00"	66.83	1.1					
WPT037	07/15/03	N60°57'55.00"	W160°11'18.00"	66.88	1.1					
33 sinuosity				66.89	1.1					
WPT036	07/15/03	N60°58'00.00"	W160°11'14.00"	67.08	1.2					
WPT035	07/15/03	N60°58'01.00"	W160°11'14.00"	67.13	1.2					
208	08/01/03	N60°58'03.00"	W160°11'14.00"	67.19	1.2	3	4	88	5	0
WPT034	07/15/03	N60°58'03.00"	W160°11'14.00"	67.19	1.2					
WPT033	07/15/03	N60°58'05.00"	W160°11'05.00"	67.38	1.2					
WPT032	07/15/03	N60°58'03.00"	W160°10'56.00"	67.55	1.2					
WPT031	07/15/03	N60°57'59.00"	W160°10'49.00"	67.76	1.2					
WPT030	07/15/03	N60°57'58.00"	W160°10'37.00"	67.97	1.2					
WPT029	07/15/03	N60°57'56.00"	W160°10'32.00"	68.08	1.2					
34 sinuosity				68.08	1.2					
WPT028	07/14/03	N60°57'56.00"	W160°10'15.00"	68.35	1.3					
CAMP1407	07/14/03	N60°57'55.00"	W160°10'11.00"	68.48	1.3					
221	08/04/03	N60°57'48.46"	W160°22'15.82"	68.72	1.3					
1B		N60°57'53.40"	W160°09'47.60"	68.72	1.3	0	23	66	10	0
1BHOBO	07/14/03	N60 57'51.00"	W160°09'58.00"	68.72	1.3					
WPT027	07/14/03	N60°57'51.42"	W160°09'47.52"	68.93	1.3					
WPT026	07/14/03	N60°57'52.98"	W160°09'41.58"	69.05	1.3					
WPT025	07/14/03	N60°57'52.50"	W160°09'31.44"	69.22	1.3					
WPT024	07/14/03	N60°57'52.50"	W160°09'29.28"	69.25	1.3					
WPT023	07/14/03	N60°57'53.58"	W160°09'23.22"	69.37	1.3					
WPT022	07/14/03	N60°57'54.00"	W160°09'21.00"	69.41	1.3					
35 sinuosity				69.42	1.3					
WPT421		N60°58'05.66"	W160°08'43.58"	69.66	1.9					
WPT420		N60°58'06.06"	W160°08'42.54"	69.68	1.9					
WPT021	07/14/03	N60°58'00.00"	W160°09'03.00"	69.83	1.9					
207	08/01/03	N60°58'06.67"	W160°08'27.53"	70.05	1.9	5	0	95	0	0
WPT419		N60°58'06.67"	W160°08'27.53"	70.05	1.9					
WPT418		N60°58'05.77"	W160°08'15.07"	70.08	1.9					
WPT020	07/14/03	N60°58'03.00"	W160°08'52.00"	70.13	1.9					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT019	07/14/03	N60°58'04.00"	W160°08'47.00"	70.16	1.9					
WPT018	07/14/03	N60°58'04.00"	W160°08'41.00"	70.29	1.9					
WPT417		N60°58'07.21"	W160°07'51.38"	70.34	1.9					
WPT017	07/14/03	N60°58'04.00"	W160°08'32.00"	70.44	1.9					
206	08/01/03	N60°58'09.77"	W160°07'01.85"	70.56	1.9	3	0	90	7	0
WPT416		N60°58'09.77"	W160°07'01.85"	70.56	1.9					
WPT016	07/14/03	N60°58'03.00"	W160°07'22.00"	70.61	1.9					
203	07/31/03	N60°58'21.43"	W160°5'35.808"	70.77	1.9	4	1	85	10	0
WPT015	07/14/03	N60°58'04.00"	W160°07'12.00"	70.78	1.9					
WPT415		N60°58'10.24"	W160°06'21.60"	70.96	1.9					
WPT014	07/14/03	N60°58'04.00"	W160°08'01.00"	70.97	1.9					
WPT013	07/14/03	N60°58'05.00"	W160°07'48.00"	71.19	1.9					
36 sinuosity				71.30	1.9					
WPT012	07/14/03	N60°58'05.00"	W160°07'40.00"	71.31	1.3					
WPT011	07/14/03	N60°58'05.00"	W160°07'35.00"	71.42	1.3					
WPT010	07/14/03	N60°58'06.00"	W160°07'26.00"	71.54	1.3					
WPT009	07/14/03	N60°58'06.00"	W160°07'19.00"	71.66	1.3					
WPT008	07/14/03	N60°58'06.00"	W160°07'15.00"	71.74	1.3					
WPT414		N60°58'14.56"	W160°06'03.46"	71.80	1.3					
205	08/01/03	N60°58'07.00"	W160°07'10.00"	71.86	1.3					##
WPT007	07/14/03	N60°58'07.00"	W160°07'10.00"	71.86	1.3					
CAMP1307	07/13/03	N60°58'07.00"	W160°06'51.00"	72.17	1.3					
204	07/31/03	N60°58'07.08"	W160°06'50.10"	72.18	1.3					
SPWCONF1		N60°58'07.08"	W160°06'50.10"	72.18	1.3					
WPT006	07/13/03	N60°58'07.08"	W160°06'50.10"	72.19	1.3					
WPT005	07/13/03	N60°58'07.44"	W160°06'44.76"	72.29	1.3					
WPT004	07/13/03	N60°58'07.56"	W160°06'36.54"	72.42	1.3					
WPT413		N60°58'20.57"	W160°5'47.868"	72.50	1.3					
WPT003	07/13/03	N60°58'09.72"	W160°06'24.30"	72.66	1.3					
WPT412		N60°58'21.25"	W160°5'34.836"	72.87	1.3					
WPT002	07/13/03	N60°58'12.54"	W160°06'13.32"	72.89	1.3					
WPT001	07/13/03	N60°58'15.30"	W160°06'06.66"	73.05	1.3					
SEC1	07/13/03	N60°58'18.00"	W160°05'59.00"	73.21	1.3					
Section 1 End										
WPT411		N60°58'22.80"	W160°05'40.88"	73.24	1.3					

Table A-1a. Noted points and sampling sites along the Tuluksak River (continued).

Waypoint name	Date sampled	Latitude	Longitude	Distance (rkm)	Sinuosity (rkm/km)	% fines <2mm	% gravel 2 - 15 mm	% pebble & cobble 16 - 149 mm	% lg. cobble 150 - 256 mm	% boulder >256 mm
WPT409		N60°58'22.80"	W160°05'40.88"	73.41	1.3					
CAMP1207		N60°58'21.54"	W160°05'35.56"	73.51	1.3					
202	07/31/03	N60°58'22.44"	W160°05'17.81"	73.54	1.3					
WPT410		N60°58'22.80"	W160°05'40.88"	73.54	1.3					
37 sinuosity				73.89	1.3					
A	07/12/03	N60°58'20.00"	W160°05'28.00"	73.92	1.9					
WPT406		N60°58'22.80"	W160°05'17.37"	73.97	1.9					
CAMP1107	07/11/03	N60°58'25.00"	W160°05'16.00"	74.33	1.9					
WPT405		N60°58'31.73"	W160°04'59.84"	74.51	1.9					
8KINGS	07/11/03	N60°58'29.76"	W160°05'09.72"	74.54	1.9					
201		N60°58'29.76"	W160°05'09.72"	74.54	1.9					
WPT404		N60°58'33.71"	W160°04'59.34"	74.58	1.9					
WPT403		N60°58'34.93"	W160°04'56.82"	74.66	1.9					
WPT402		N60°58'37.09"	W160°04'54.23"	74.77	1.9					
WPT401		N60°58'39.68"	W160°04'50.56"	74.89	1.9					
WPT400		N60°58'40.40"	W160°04'38.96"	75.08	1.9					
PUTIN02	07/31/02	N60°58'38.00"	W160°04'33.00"	75.36	1.9	0	0	90	10	0
PUTIN03	07/11/03	N60°58'38.00"	W160°04'33.00"	75.36	1.9					
38 sinuosity				75.77	1.9					
Nugget Creek				92.88	1.3					

Table A-1b. Noted points and salmon observations along the Tuluksak River. Coordinates use the WGS-84 datum. Distances from the USFWS weir to waypoints was traced from topographic maps. The weir is 56 rkm upstream from the Tuluksak/Kuskokwim confluence. RR refers to the right hand bank of the river as you are facing downstream. Notes were taken on channel features, salmon observations and behavior, possible camp sites, and vegetation. 'Spawning' salmon were observed holding over redds or potential spawning sites. Some sections of the channel were marked frequently to get a 'trace' of the channel to compare to the topographic map.

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
TULWIER	0.00							USFWS resistance board weir.
Section 6 start. Weir is 0 rkm for all referenced points								56 rkm from Tuluksak confluence with Kuskokwim
1 sinuosity	1.70							
WPT399	3.18	1						
2 sinuosity	3.44							
6E	4.22							
6EHOBO	4.22							
3 sinuosity	7.62							
4 sinuosity	9.22							
6C	10.52							
5 sinuosity	12.31							
6 sinuosity	13.93							
WPT398	16.14					Pool		Near HOBO site
WPT397	16.20					Pool		
WPT396	16.27							
WPT395	16.33						Grass	Cutbank RL
WPT394	16.39							Cutbanks RL and RR
WPT393	16.43			5		Pool		Pool RR, bar RL
WPT392	16.47							Gravel bars RL and RR
7 sinuosity	16.50							
WPT391	16.55						Grass	Grass RR, cutbank RL
WPT390	16.65					Riffle		
WPT389	16.76					Riffle		Backwater
WPT388	16.79						Grass	
WPT387	16.86						Grass	
WPT386	16.92						Grass	
WPT385	16.99					Pool	Grass	Pool RL, grass RR
WPT384	17.02					Pool	Grass	Pool RL, grass RR
6HAB	17.33							
6HABHOBO	17.33							
WPT383	17.53							Beaver dam RL

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT382	17.89	2				Pool		Chinook salmon holding in a pool
WPT381	20.21	1		5				
8 sinuosity	20.64							
Section 5 start. Section 6 end								Section 5 start. Section 6 end
5I	21.70							
WPT380	23.61					Pool		Small bar RR, pool RL
WPT379	23.68			2		Riffle		Crest of a riffle
WPT378	23.74					Glide		
WPT377	23.79					Pool		Gravel bar RL, pool RR
WPT376	23.84							
WPT375	23.92					Pool		Corner pool
WPT374	24.05					Riffle		Small gravel bar RR
WPT373	24.14					Glide		
WPT372	24.20					Pool		Corner pool
WPT371	24.28	1				Riffle		Small gravel bar RL, riffle to run
WPT370	24.34			5				Chum in a corner pool
WPT369	24.38					Glide		
WPT368	24.43							River bend, pool
9 sinuosity	24.48							
WPT367	24.48					Pool		Corner pool
WPT366	24.54						Alder	Alder brush RR, grass RR
WPT365	24.63					Pool		Corner pool
WPT364	24.67							Apex of gravel bar
WPT363	24.73					Pool		Corner pool
WPT362	24.85					Riffle		Crest of a riffle
WPT361	24.92					Glide		Straight deep glide
WPT360	24.99							End of gravel bar
WPT359	25.18			5		Pool		Deep pool, chum salmon near top of gravel bar
5G	25.67							
WPT358	25.85							Gravel bar
WPT357	25.87					Pool		Corner pool
WPT356	25.90							Apex of gravel bar
WPT355	25.92							Gravel bar
WPT354	26.00						Tundra	Gravel bar RR, open tundra RL
WPT353	26.07							Corner pool

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT352	26.11					Pool		Corner pool
WPT351	26.17					Riffle		Crest of riffle
WPT350	26.26							Corner pool
WPT348	26.31							Corner pool
WPT349	26.31							Apex of gravel bar
WPT346	26.41							Corner pool
WPT347	26.41					Glide		Glide, top of riffle
WPT345	26.49							Apex of gravel bar
WPT344	26.94							Small gravel bar
WPT343	27.02							
WPT342	27.13							Small gravel bar
WPT341	27.30							Small gravel bar
WPT340	27.40					Pool		Deep pool RL, small bar RR
10 sinuosity	27.45							
WPT339	27.52			5				Some chum salmon
WPT338	27.59			10				Lots of chum salmon
WPT337	27.70			10				Lots of chum salmon
5E	27.74							
WPT336	27.86			30	S			Large chum spawning site
WPT335	28.03					Pool		Gravel bar RL, pool RR
WPT334	28.40	1				Pool		Huge pool, small gravel bar RL
WPT333	28.46			15				Chum salmon
WPT332	28.77	2						
WPT331	28.97	1						
WPT330	29.03			15	S			Spawning chum salmon
WPT329	29.18	2		10				Chinook salmon and possible sockeye salmon
11 sinuosity	29.68							
WPT328	29.74	1						
5C	30.18							
WPT327	30.25					Run	Alder	Overhanging alders
WPT326	32.61	1		5				
WPT325	32.80					Run	Alder	Overhanging alders, channel split
WPT324	32.87	1		5				
12 sinuosity	32.88							
WPT323	33.00					Backwater		Beaver dam RR, top of gravel bar RL

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT322	33.11			10		Run		Small gravel bar RR
WPT321	33.41					Pool		
WPT320	33.48					Riffle		Riffle-run-riffle
WPT319	33.57					Pool		Gravel bar RR, pool RL
WPT318	33.70	3				Pool		Deep pool
WPT317	33.81	1		5		Hole		Chum in deep pool
WPT316	34.03	3				Hole		Chinook salmon in deep hole RL
WPT315	34.10	2				Hole		Chinook salmon in deep hole RL
5HAB	34.24							
5HABHOB	34.24							
WPT314	34.26			2				HOBO site. Two chum salmon carcasses
WPT313	34.64	1						
Section 5 end. Start Section 4								Section 5 end. Start Section 4
WPT312	34.73	1		1				One Chinook salmon, one chum, possibly 12 Dolly Varden
13 sinuosity	34.80							
WPT311	35.01	1						
4D	35.07							
WPT310	35.07					Pool		Gravel bar RL, pool RL
ELEVATION100	35.60							
WPT309	35.71	1		5		tundra		Channel split, exposed tundra bank
4C	35.84							
WPT308	35.84					Pool		Gravel bar, 2002 campsite. Sockeye salmon in pool
14 sinuosity	35.98							
WPT307	36.23							HOBO site
WPT306	36.34			30				Large school of chum
JGRDNT	36.34							
WPT305	36.40	1		1				Chinook salmon and chum salmon swimming upstream
WPT304	36.50					Pool		Deep pool, water more turbid
4CMP3	36.73							
4CMP3HOBO	36.73							
WPT303	36.73							2002 camp site. HOBO missing (snapped cable)
WPT302	37.02			10				Ten chum salmon
WPT301	37.21	1		1				Huge Chinook salmon, four pinks, one chum
15 sinuosity	37.26							
WPT300	37.31			20				Lots of chum near top of small gravel bar

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT299	37.44			20				Lots of chum near top of small gravel bar
WPT298	37.61	2						
WPT297	37.74			10				One sockeye salmon, ten chum salmon
4HAB	37.76							
WPT296	37.83	3				Pool		Chinook salmon in pool
WPT295	38.03	3				Pool		Gravel bar
WPT294	38.26	2						
WPT293	38.62	18		8		Pool		Chinook salmon and sockeye in deep RR pool
WPT292	38.91	2		4		Riffle		Riffle, pool
WPT291	39.01	1						
16 sinuosity	39.06							
WPT290	39.22	1				Pool		Pool
4CMP2	39.34							
WPT289	39.37							Gravel bar, campsite
WPT288	39.48						Woody debris	Gravel bar below log jam. Obstructed channel
WPT287	39.66	3						
WPT286	39.98	6		1		Pool		Corner pool, one huge Chinook salmon with five smaller
WPT285	40.08			20		Run		Large group of chum
WPT284	40.17	2		1				Small gravel bar RR
WPT283	40.25	2						Chinook salmon along RL bank
WPT282	40.28	1				Pool		Chinook salmon in RL pool, gravel bar RR
WPT281	40.41					Pool		Deep pool
WPT280	40.54					Riffle		Mid-channel riffles, possible sockeye
WPT279	40.72					Eddy	Woody debris	Large woody debris, channel splits, eddies
WPT278	40.83							End of channel split
17 sinuosity	40.89							
WPT277	40.90							Channel split (took RR channel). Small campsite
WPT276	41.18					Pool		Gravel bar RR, pool RL
4A	41.27							
WPT275	41.27							Channel split, took middle/RL channel
WPT274	41.44							Small gravel bar
WPT273	41.54					Riffle		Riffle
WPT272	41.61					Pool		Deep pool
Section 4 end. Start Section 3								Section 4 end. Start Section 3

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT271	41.80			10	S			Chum salmon spawning RR
WPT270	41.91							Top of gravel bar
WPT269	41.96	6						Chinook salmon
WPT268	42.20							Top of gravel bar
WPT267	42.29					Pool		Deep pool RL
WPT266	42.38							Side channel RL
WPT265	42.47							Top of gravel bar RR
WPT264	42.59					Riffle		Top of low gradient riffles
3G	42.80							
3GHOBO	42.80							
WPT263	42.80							Top of gravel bar
WPT262	42.83	1				Riffles		Chinook salmon RL, mid-channel riffles RR
WPT261	42.97					Eddy		Backwater
WPT260	43.06					Pool		Deep pool
18 sinuosity	43.07							
WPT259	43.16					Riffle		Backwater
WPT258	43.30					Pool		End of exposed tundra. Sandy pool, gravel bar
WPT257	43.38						Tundra	Open tundra RR, small gravel bar RL
WPT256	43.55	1				Glide		Long glide-run
WPT255	43.64						Marsh	Swamp along bank
WPT254	43.81	1	1					
WPT253	43.88	1				Pool		Small gravel bar, Chinook salmon in pool RL
WPT252	43.98	2						More Chinook salmon
WPT251	44.03	3				Pool		Deep pool RR with one jack Chinook salmon
WPT250	44.11						Woody debris	End of RR gravel bar, side channel rejoins, log jam
WPT249	44.17					Pool		Gravel bar RR, good campsite, pool RL
WPT248	44.30						Erosion	Chunk of river bank mid-channel. Mossy substrate
WPT247	44.35					Pool		Deep pool
WPT246	44.43			3		Riffle		Gravel bar RR
WPT245	44.51	1				Pool		Pool, Chinook salmon traveling upstream
WPT244	44.58					Pool		Deep corner pool, small gravel bars RL
WPT243	44.74			20				Narrow gravel bar RR, chum salmon
WPT242	44.81			20				School of chum salmon
WPT241	44.88	1				Pool		Pool tailout, Chinook salmon in pool
WPT240	44.94					Riffle		Mid-channel bar

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
19 sinuosity	44.96							
WPT239	44.99					Pool		End of large corner pool
3F	45.10							
WPT238	45.10					Pool		Large corner pool
WPT237	45.19					Pool		
WPT236	45.24	1		1			Woody debris	End of gravel bar RR, woody debris
WPT235	45.26					Riffle		Riffle, top of gravel bar
WPT234	45.28					Eddy		End of gravel bar RL, backwater
WPT233	45.39			1		Pool		Small gravel bar RL, pool and glide RR
WPT232	45.56					Creek	Woody debris	Water inlet RR, possible feeder creek
WPT231	45.63					Pool		Pool RL
WPT230	45.72	2				Pool		Pool tailout with Chinook salmon, midchannel bars
WPT229	45.82					Riffle		Small bar RR, pool RL, sockeye going upstream
WPT228	45.89					Riffle	Woody debris	Channel split (took RL), point bar RL
WPT227	46.05					Run		End of small split, midchannel bar, gravel bar RL
WPT226	46.12					Riffle		End of RR gravel bar, start of RL gravel bar, riffle
WPT225	46.26			1				Gravel bar RR
WPT224	46.32					Glide		Pool tailout, glide
WPT223	46.41					Hole		Water saturated gravel bar RL, deep hole RR
WPT222	46.50					Riffle		End of RL gravel bar
WPT221	46.59					Pool		End of gravel bar, riffle transitioning to deep pool
WPT220	46.70					Pool		Pool
WPT219	46.75					Riffle		Gravel bar RR
20 sinuosity	46.77							
WPT218	46.78					Riffle		Gravel bars RL
WPT217	46.84					Riffle		
WPT216	46.89					Glide		End of channel split, small gravel bar
WPT215	47.06							Beaver dam, small gravel bars
3E	47.07							
WPT214	47.29	1				Run		Small gravel bars RR, side channel
WPT213	47.32					Run	Cutbank	Cutbanks
WPT212	47.37					Riffle		
WPT211	47.43					Pool		Run, transitioning to glide, pool RR, small bar RL
WPT210	47.46					Riffle		Riffle transitioning to run
WPT209	47.49							Gravel bar

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT208	47.52							Gravel bar
WPT207	47.54							Gravel bar
WPT206	47.66						Alders	Small gravel bar RR. Overhanging vegetation
WPT205	47.71					Run	Woody debris	Channel split (took RR), woody debris, run
WPT204	47.74			10				Gravel bar RL, chum
WPT203	47.83					Pool		Deep pool RR, gravel bar RL
WPT202	47.86					Riffle		End of gravel bar, top of riffle
WPT201	47.92					Pool		End of riffle, deep pool RR
WPT199	48.00					Pool		Corner Pool
WPT198	48.04							Apex of gravel bar
WPT197	48.07					Pool		top of gravel bar, pool RL
WPT196	48.11					Glide		
WPT195	48.14					Glide		
WPT194	48.17					Run	Alders	Overhanging vegetation
WPT193	48.20					Riffle		Riffle
WPT192	48.22					Run		Run
WPT191	48.24					Run		Run
WPT190	48.25					Glide		Glide
WPT189	48.27							Downstream end of bar
WPT187	48.29			10				Chum salmon and grayling
WPT188	48.29							Apex of gravel bar
WPT186	48.39							Gravel bar
WPT185	48.43					Glide		Glide
21 sinuosity	48.44							
WPT184	48.47					Pool		Corner pool
WPT183	48.48							Apex of gravel bar
WPT182	48.51					Pool		Pool RR, ok gravel bar RL
WPT181	48.68					Pool		Pool RR, ok gravel bar RL
220	48.91							
WPT180	48.91	2			P	Riffle		Chinook salmon possibly being chased of chum redds
WPT179	49.03	6	6					Two Chinook salmon RL, possible redds
3D	49.05							
WPT178	49.09					Pool		Deep pool RL, gravel bar RR
WPT177	49.25					Glide		Long glide, deep pool RR, lots of firewood
WPT176	49.38					Pool	Woody debris	Deep pool, lots of woody debris

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT175	49.46							
WPT174	49.52					Braids		Channel splits with mid-channel bars
WPT173	49.63					Pool		Deep corner pool, uncomfortably small camp
3CAMP1	49.68							
WPT172	49.69						Woody debris	Camp site, HOBO missing, lots of woody debris
WPT171	49.80					Pool		Deep pool
WPT170	49.88					Pool		Corner pool
WPT169	50.02					Pool	Woody debris	Bottom of riffle, pool. Woody debris RR
22 sinuosity	50.09							
WPT168	50.11					Riffle		Top of riffle, small bar RR
WPT167	50.19	3				Pool		Corner pool, gravel bar RL
WPT166	50.23					Pool		Corner pool, small gravel bar RR
WPT165	50.49			12		Hole		Deep hole, small gravel bar RR, flat glide
WPT164	50.59							HOBO site
3C	50.67							
3CHOBO	50.67							
3HI3	50.67							
WPT448	50.88							
WPT163	50.95					Pool		Deep pool
WPT162	51.13							Small flat gravel bar
WPT161	51.24						Log jam	Log jam partially obstructing channel
WPT160	51.37							Gravel bar RR
WPT159	51.50					Run	Sweepers	End of narrow channel with overhanging trees
WPT158	51.64							Channel split, gravel bar RL, ok campsite
WPT447	51.67							
WPT157	51.77	10	10					Chinook salmon redd
WPT446	51.77							
23 sinuosity	51.82							
WPT445	51.85							
WPT156	51.90	8	8					Chinook salmon holding
3HAB	52.02							
WPT155	52.04					Riffle		Top of riffles, small midchannel bar RR
WPT154	52.17					Pool	Sweepers	End of pool, top of riffle with sweepers
WPT444	52.26							
WPT153	52.30					Hole	Spruce	Hole RL, standing dead spruce RR

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT152	52.44							End of channel split
WPT151	52.56							Channel split with mid-channel bar
WPT150	52.65	1						Chinook salmon along RL bank
WPT149	52.77	1				Pool		Deep corner pool, Chinook salmon going upstream
WPT148	52.83	2		1				Chinook salmon going upstream
WPT147	52.92					Pool		Deep pool with side channel
3B	53.00							
WPT145	53.00					Riffle		Mid channel bars, top of riffles
WPT146	53.00			1		Riffle		End of riffle
WPT144	53.05					Riffle		Riffle transitioning to glide run
WPT143	53.10					Riffle		Top of riffle
219	53.21							
WPT142	53.21	1						
WPT141	53.36	1	1			Pool		Very deep pool, possible spawning at tailout
WPT140	53.46					Pool	Woody debris	Backwater, large area of woody debris in channel
WPT139	53.59							Beaver dam with large pool RL
24 sinuosity	53.69							
WPT138	53.85	1						Gravel bar, lots of firewood
WPT137	53.95					Pool		Deep pool RL
218	54.06							
WPT443	54.06							
WPT136	54.08					Braid		Braided channel mid channel bars, pool RL
ELEVATION175	54.10							
WPT135	54.15	9		1				
WPT134	54.35						Sweepers	Cobble bar RL
WPT133	54.45							Gravel bar RR
WPT132	54.52	1						Chinook salmon holding over a redd
WPT131	54.56					Pool		Deep pool, gravel bar
WPT130	54.63					Pool		Deep pool, gravel bar
3A	54.71							
3AHOBO	54.71							
WPT129	54.76	1				Glide		HOBO, Chinook salmon going upstream
WPT128	54.79	2					Erosion	Chunk of bank in channel
WPT442	54.92							
WPT127	55.01					Glide		Side channel RR, long glide with pools along bar

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
25 sinuosity	55.05							
WPT126	55.08							Camp site, not much wood
WPT125	55.16	13				Riffle		Chinook salmon in riffle
217	55.17							
WPT441	55.17							
WPT124	55.24	2		25				Chinook salmon at top of channel split, chum spawning RL
WPT123	55.32	1				Glide		Long still glide
WPT122	55.41	5				Glide		Long glide, Chinook salmon possibly going upstream
Section 3 end. Start Section 2								Section 3 end. Start Section 2
WPT121	55.68	1				Riffle		Low gradient riffle, good camp site
WPT120	55.70	1						End of gravel bar RR
WPT119	55.82	2				Pool		Glide and pool. Good gravel bar camp RR
WPT118	55.88							Gravel bar-camp site RR
WPT117	56.03	3				Riffle		Gravel bar RL- good camp site
WPT116	56.06					Pool		Deep pool
WPT115	56.15	2						gravel bar RL- good camp site
WPT114	56.31	2	2		P	Braids		Possible redds at mid-channel bar
2DHOBO	56.34							
2D	56.30							
WPT113	56.55						Sweepers	Gravel bar RR, spruce sweepers
26 sinuosity	56.82							
WPT112	56.83					Riffle	Tundra	Small gravel bar RR, open tundra RL
WPT111	56.92					Glide		End of channel split
WPT110	57.04					Run		
216	57.08							
WPT440	57.08							
WPT109	57.09					Riffle		Top of riffle
WPT108	57.14	4				Riffle		Chinook salmon RR above riffle
WPT107	57.22					Glide		Glide between low gradient riffles
WPT439	57.28							
2HAB	57.32							
2HHOBO	57.32							
GAR045	57.36							
WPT438	57.41							
WPT105	57.45	2					Sweepers	HOBO, trees over corner pool, sockeye holding

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT104	57.51	1				Pool		Deep pool with Chinook salmon. Gravel bar RL
WPT103	57.58	2				Pool		Corner pool
215	57.63							
WPT437	57.63							
WPT102	57.66	6		1				Chinook salmon going upstream
WPT101	57.70	2						Chinook salmon going upstream
WPT100	57.73							Beaver dam RR
WPT106	57.73					Pool		Deep pool
GAR046	57.82							
WPT099	57.82	2				Pool	Sweepers	Possible sockeye spawning habitat
WPT098	58.09	3				Pool	Sweepers	Deep pool
WPT097	58.24					Riffle		Gravel bar RR
WPT096	58.30	1				Pool		Chinook salmon above pool
27 sinuosity	58.31							
WPT095	58.37	1						Chinook salmon RL, possible holding
GAR038	58.40							
WPT094	58.71						Log jam	Channel split, log jam
214	58.80							
WPT436	58.80							
WPT093	58.83					Pool		Gravel bar RR, one Chinook salmon in pool
WPT092	58.91					Riffle		Low gradient riffle
2C	58.99							
2CHOBO	59.00							
WPT091	59.06					Riffle	Cutbank	Cutbank RR, low gradient riffle RL
WPT090	59.27					Glide		Glide between low gradient riffles
WPT089	59.38					Braids		Shallow splits and braided area
WPT088	59.59					Riffle		Mid channel bars, top of low gradient riffles
WPT087	59.77			3		Glide	Sweepers	Riffle, top of glide. Overhanging vegetation
213	59.78							
WPT435	59.78							
WPT086	59.91					Glide		Mid-channel bars
WPT434	59.94							
WPT085	59.97	1	1				Cutbank	Chinook salmon, possibly holding over redd
WPT084	60.03	2	2			Glide		Chinook salmon in deep area, possibly holding over redd
WPT083	60.13	1					Tundra	Tundra RL

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
212	60.19							
WPT433	60.19							
WPT432	60.27							
WPT082	60.43					Riffle		End of channel split
28 sinuosity	60.45							
WPT081	60.58					Riffle		End of riffle.
WPT080	60.70	1						Chinook salmon RR
WPT079	60.83					Riffle		Top of riffle
210	61.06							
CAMP1707	61.06							Gravel bar camp
2BHOB	61.17							
2B	61.18							
WPT078	61.19					Pool		Deep corner pool
WPT077	61.36							Lots of mid-channel bars, fresh bank erosion
WPT431	61.43							
WPT076	61.53					Riffle		Riffle to run, bar RR, channel splits
WPT075	61.77	1				Riffle		Channel split
WPT430	61.77							
WPT429	61.93							
WPT074	62.08	5	5					Possible chum spawning
WPT073	62.10					Riffle		Riffle-run-riffle. Small side channel
WPT072	62.24	1				Glide		Chinook salmon along RR bank in glide
WPT071	62.27					Riffle		Top of riffle
29 sinuosity	62.33							
WPT070	62.35					Riffle		Top of riffle
WPT428	62.37							
WPT069	62.50	2				Riffle		Glide transitioning to riffle
2AHOBO	62.65	2	2					Chinook salmon traveling upstream or holding
2A	62.65							
WPT068	63.21	1				Run		Chinook salmon along bank at top of run
WPT427	63.25							
WPT426	63.34							
WPT425	63.47							
WPT424	63.54							
30 sinuosity	63.57							

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT423	63.65							
WPT067	63.93					Run		Glide transitioning to run
CAMP1507	63.94							
WPT060	63.94					Glide		Glide transitioning to run-riffle
WPT061	63.94			2	S			
WPT062	63.94	1				Pool		
WPT063	63.94							Channel split (took RR)
WPT064	63.94					Pool		Deep corner pool
WPT065	63.94					Riffle		Top of riffle-run
WPT066	63.94					Glide		Run transitioning to glide
WPT059	64.04					Pool		Deep corner pool
WPT058	64.28	6				Run	Sweepers	Chinook salmon along RR bank below overhanging trees
WPT057	64.38	8				Run	Sweepers	Cut bank with overhanging birch
WPT056	64.42			2				
WPT055	64.59					Run		Beaver dam RR, long run
31 sinuosity	64.71							
WPT054	64.72					Pool		Pool, mid-channel bars
WPT053	64.77					Pool	Cutbank	Cutbank with grass, trees, possibly sockeye
WPT052	64.90					Pool	Cutbank	Cutbank with grass, trees, possibly sockeye
WPT051	65.04	1						
CHMCABIN	65.27	2	2	20	S			Chum spawning, Chinook salmon going upstream &holding
Section 2 End. Start Section 1								Section 2 End. Start Section 1
WPT049	65.34			13				
WPT050	65.36			3				Channel split (took RL), chum
WPT048	65.47	10					Woody debris	Cut bank, gravel bar. Chinook salmon below woody debris
WPT422	65.50							
209	65.64							
WPT047	65.64	3	3			Riffle		Gravel bar RR, possible spawning RR
WPT046	65.77	1				Run		Beaver dam
32 sinuosity	65.83							
WPT045	65.87	1				Pool		Rock bluff at foothills. Campsite. Prominent landmark
WPT044	66.21	1				Riffle		Jack Chinook salmon in riffle
WPT043	66.27					Glide		
WPT042	66.44	16		3		Pool		Chinook salmon in channel and pool
WPT041	66.57	2	2					Channel split, Chinook salmon spawning RR

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT040	66.68	1				Glide		Chinook salmon traveling upstream
WPT039	66.73					Pool		Deep hole RL
ELEVATION250	66.74							
WPT038	66.83	1				Riffle		Chinook salmon mid riffle
WPT037	66.88	1				Riffle		Riffle
33 sinuosity	66.89							
WPT036	67.08					Riffle		Channel split (took RR)
WPT035	67.13					Pool		Deep pool
208	67.19							
WPT034	67.19					Plunge Pool		Riffle, run, riffle. Plunge pool
WPT033	67.38	3				Glide		Split, end of glide with 3 Chinook salmon, start of riffle
WPT032	67.55	3				Pool		Small sediment bluff, Chinook salmon in pool
WPT031	67.76	3				Run	Sweepers	Top of run, Chinook salmon under overhanging spruce
WPT030	67.97	5	5			Run		Possible spawning RR
WPT029	68.08	3						Two large Chinook salmon and one jack going downstream
34 sinuosity	68.08							
WPT028	68.35	3	3					Spawning
CAMP1407	68.48							Campsite, gravel bar
221	68.72							
1B	68.72							
1BHOBO	68.72							
WPT027	68.93	7	7					Two Chinook salmon RR, rest chasing along RL
WPT026	69.05	3					Woody debris	Chinook salmon below woody debris
WPT025	69.22	3						Chinook salmon traveling upstream
WPT024	69.25	3						Chinook salmon traveling upstream
WPT023	69.37	4				Run		Mid-channel bar
WPT022	69.41	5						
35 sinuosity	69.42							
WPT421	69.66							
WPT420	69.68					Run		
WPT021	69.83	1				Riffle		End of split, start of run
207	70.05							
WPT419	70.05							
WPT418	70.08							
WPT020	70.13	6	6			Riffle		Channel split. Chinook salmon holding

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT019	70.16	1				Pool		Exposed rock face with pool
WPT018	70.29	1				Riffle		Chinook salmon above riffle. Mid-channel bars
WPT417	70.34							
WPT017	70.44	1				Run		Mid-channel bars
206	70.56							
WPT416	70.56							
WPT016	70.61	9	9			Riffle		End split. Riffles, Chinook salmon possibly holding on redd
203	70.77							
WPT015	70.78					Riffle		Split (took RR)
WPT415	70.96							
WPT014	70.97	3	3			Run		Chinook salmon in run, possible red
WPT013	71.19					Run		Riffle to run
36 sinuosity	71.30							
WPT012	71.31	3				Riffle		Start of riffle. One Chinook salmon in side channel
WPT011	71.42	2				Pool	Woody debris	End riffle. Pool with woody debris
WPT010	71.54	2				Riffle		Channel split
WPT009	71.66					Run		Run
WPT008	71.74	1				Riffle		Riffle
WPT414	71.80							
205	71.86							
WPT007	71.86	6	6					
CAMP1307	72.17	10	10	1		Run		Island in channel
204	72.18							
SPWCONF1	72.18							
WPT006	72.19	6				Run		Island in channel
WPT005	72.29							
WPT004	72.42					Run		
WPT413	72.50							
WPT003	72.66					Riffle		End of channel split
WPT412	72.87							
WPT002	72.89	1				Pool		Start of channel split, pool
WPT001	73.05					Run		
SEC1	73.21	1		1		Run		Start of Section 1
Section 1 End								
WPT411	73.24							

Table A-1b. Noted points and salmon observations along the Tuluksak River (continued).

Waypoint name	Distance (rkm)	Chinook salmon observed	Chinook salmon spawning	Chum salmon observed	Chum salmon spawning	Channel type	Bank cover	Habitat note
WPT409	73.41							
CAMP1207	73.51							Campsite
202	73.54							
WPT410	73.54							
37 sinuosity	73.89							
A	73.92	1	1					
WPT406	73.97							
CAMP1107	74.33	1						Campsite
WPT405	74.51							
8KINGS	74.54	20	20					Chinook salmon spawning area
201	74.54							
WPT404	74.58							
WPT403	74.66							
WPT402	74.77							
WPT401	74.89							
WPT400	75.08							
PUTIN02	75.36							Start of Raft trips. Gravel bar RL.
PUTIN03	75.36	7						Abandoned dredge is near put-in site, upstream, off RR bank.
38 sinuosity	75.77							
Nugget Creek	92.88							Flows into Tuluksak River headwaters

Table A-2. Aerial surveys of the Tuluksak River and tributaries. The data is from raw Alaska Department of Fish and Game aerial surveillance forms and includes information from surveys taken under fair and poor conditions.

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
7/20/65	Tuluksak	100	96			100				3	20	1	3	ADFG
	From 10 miles above Fog River to 1 mile below Nyac. ADFG is the Alaska Department of Fish and Game													
7/11/66	Tuluksak	100								6			3	ADFG
	A few spawning kings seen													
7/22/68	Tuluksak	100	110			1,100				1			2	ADFG
7/17/76	Tuluksak	100	139		1	5,463				1	15		2	ADFG
	One king above Nyac, all chums below foothills. A few kings above foothills													
7/21/77	Tuluksak	100	437	2		2,069	2			1		1	1	ADFG
7/21/77	Tuluksak	101	290	1		2,058				1		1	1	ADFG
	101: mouth to foothills													
7/21/77	Tuluksak	102	1	1		11				1		1	1	ADFG
	102: foothills to Nyac													
7/21/77	Tuluksak	103	15							1		1	1	ADFG
	103: above Nyac													
7/21/77	Bear Creek	100	1							1		1	3	ADFG
	Stream very muddy below dredge. Very good channel around dredge. Effluent having minimal affect on Tuluksak turbidity. King seen above dredge.													
7/18/78	Tuluksak	100	403			2,006	1			1	45	1	2	ADFG
	Survey begun half way between Kusko confl. And Mts. River turbid below. Vis into water low. Conditions good above. No salmon in Bear Creek													
9/20/78	Tuluksak	100						64		6	16	1	1	ADFG
	Surveyed from Nyac downstream to last hill													
7/23/80	Tuluksak	100	1,035			56,035				1	60	2	2	ADFG
7/23/80	Tuluksak	101	725			55,525				1	60	2	2	ADFG
7/23/80	Tuluksak	102	250			510				1	60	2	2	ADFG
7/23/80	Tuluksak	103	60							1	60	2	2	ADFG

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-2. Aerial surveys of the Tuluksak River and tributaries (continued).

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
8/8/81	Tuluksak	102	7	5						1	5	3	3	ADFG
	Two miles below Nyac muddy water influx from dredge pond completely obscured counts; survey was terminated, investigation initiated.													
7/10/83	Slate Creek	100	1							2	1	1	1	NGDC
	From Tuluksak upstream one mile. NGDC is Northern Gold Dredge Company													
7/10/83	Tuluksak	100	67			200				2			1	NGDC
	Only surveyed above Otter Creek													
7/10/83	Tuluksak	101	30			200				2			1	NGDC
7/10/83	Tuluksak	102	37			1				2			1	NGDC
	103 was not surveyed. Saw more than 200 live chum.													
7/21/83	Tuluksak	100	54	2	9	74	3			2		2	1	NGDC
7/21/83	Tuluksak	101	33	1	7	74	3			2		2	1	NGDC
7/21/83	Tuluksak	102	21	1	2					2		2	1	NGDC
	103 was surveyed from Otter Creek. 103 was not surveyed													
7/21/83	Slate Creek	100	1							2	4	2	1	NGDC
7/29/83	Tuluksak	100	201	1	31	1,026	66	0		8	77	2	1	ADFG
7/29/83	Tuluksak	101	131	0	17	1,005	66	0		8	77	2	1	ADFG
7/29/83	Tuluksak	102	70	1	14	21	0	0		8	77	2	1	ADFG
7/29/83	Tuluksak	103	0	0	0	0	0	0		8	77	2	1	ADFG
	Survey was conducted on foot and by raft from Nugget Creek to about 4 air miles above the Fog River from 21 July to 29 July. Based on size of kings, 87 were jacks. Only kings that were no longer migrating were counted, so double counts are unlikely. King survey is complete, as no kings were seen for the last 10 miles of lower end of survey. Chums were still common on lower section when count was concluded, chum count incomplete.													
7/29/83	Tuluksak	100	170	16		1,610	52			1	72	3	2	ADFG
7/29/83	Tuluksak	101	117	12		1,540	52			1	72	3	2	ADFG
7/29/83	Tuluksak	102	53	4		70	0			1	72	3	2	ADFG
7/29/83	Tuluksak	103	0	0		0	0			1	72	3	2	ADFG
	Low kings, low-average chum													

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-2. Aerial surveys of the Tuluksak River and tributaries (continued).

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
7/29/83	Bear Creek	100	0							1	5	3	2	ADFG
	Surveyed mouth to 5 miles upstream.													
7/30/83	Bear Creek	100								7	10	1	1	ADFG
	Coho fry were collected between Bonanza Creek and the East fork. Char were found at confluence with Fox Creek.													
7/31/83	Fog River	100	31	5	15	319	0	0		7	30	2	1	ADFG
	The survey ended about 5 miles above Tuluksak due to stained water. Most of the kings were in foothill area. Chum were out on flats. Coho fry were collected at the base of Fisher Dome.													
8/1/83	Tuluksak	100	1							7	10	3	3	ADFG
8/1/83	Tuluksak	101								7	10	3	3	ADFG
8/1/83	Tuluksak	101	1							7	10	3	3	ADFG
8/1/83	Tuluksak	103	0							7	10	3	3	ADFG
	Only surveyed areas 103 and 102 due to poor conditions.													
9/8/83	Tuluksak	100						373		1	70	1	2	ADFG
9/8/83	Tuluksak	101						75		1	70	1	2	ADFG
9/8/83	Tuluksak	102						283		1	70	1	2	ADFG
9/8/83	Tuluksak	103						15		1	70	1	2	ADFG
	Ended survey about 7 miles above Nyac													
9/15/83	Granite Creek	100						6		9	2	1	2	ADFG
	Surveyed to the north boundary of section 3. Four of the six coho were in a school in the mouth of the creek. They remained there through the 16th. The other two coho were above all the mined area. Very difficult to see since they were laying in a deep pool on shadow side of stream. If other fish were located in similar locations the count is very low.													
9/16/83	Tuluksak	100						62		9	1.5	1	3	ADFG
9/16/83	Tuluksak	101								9	1.5	1	3	ADFG
9/16/83	Tuluksak	102						62		9	1.5	1	3	ADFG
	Only index area 102 was surveyed and only from the lower bridge to Granite Creek. No spawning activities were observed. All fish were holding in pools.													

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-2. Aerial surveys of the Tuluksak River and tributaries (continued).

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
7/13/84	Tuluksak	100	63			2,848				6		1	1	ADFG
7/13/84	Tuluksak	101	41			2,838				6		1	1	ADFG
7/13/84	Tuluksak	102	22			10				6		1	1	ADFG
	Area 101 was excellent. Area 102 was hindered by use of 172 which was a bit fast for job, but second pass worked well. Ended survey at Bear Creek													
7/13/84	Tuluksak	100	117			1,635				6	50	1	2	ADFG
7/13/84	Tuluksak	101	93			1,625				6	50	1	2	ADFG
7/13/84	Tuluksak	102	24			10				6	50	1	2	ADFG
	Survey began at Fog River confluence and ended at Bear Creek.													
7/24/84	Slate Creek	101	4		1					9	1	2	1	ADFG
	Only surveyed from Tuluksak to hydropower ditch.													
7/24/84	Tuluksak	102	21	7	5					9	5	2	1	ADFG
	Surveyed downstream of Slate Creek to approx. 1 mile below Dry Creek. See Scott and Weagle survey for same day.													
7/24/84	Tuluksak	103	25							9	5	2	1	ADFG
	Ken Weagle with Northland as consulting biologist did survey from upper bridge to Bear Creek hydro ditch confluence.													
7/24/84	Tuluksak	102	57							9	6	2	1	BLM
	Granite Creek to Nyac. (BLM: Bureau of Land Management)													
8/30/84	Tuluksak	100						657		1		1	2	ADFG
8/30/84	Tuluksak	101						657		1		1	2	ADFG
	Survey flown only from Nyac to roughly seven miles above Fog River confluence because of murky water.													
7/20/85	Tuluksak	100	29							9	5	2	1	PrCo
7/20/85	Tuluksak	102	9							9	5	2	1	PrCo
7/20/85	Tuluksak	103	20							9	5	2	1	PrCo
	Foot survey done by R. Hoffman, private consultant (PrCo) for Northland mining co. from Northland bridge (Slate Creek) to California Creek.													

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-2. Aerial surveys of the Tuluksak River and tributaries (continued).

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
7/25/85	Tuluksak	100	142			3,182	116			6		2	1.3	ADFG
7/25/85	Tuluksak	101	135			3,092	116			6		2	1.3	ADFG
7/25/85	Tuluksak	102	7			90				6		2	1.3	ADFG
	Survey conditions near optimum. Survey began at Nyac and ended 3 miles above the Fog River confluence.													
10/14/85	Tuluksak	103						3		7	10	3	3.12	ADFG
	Survey combined aerial/foot. A coho in good condition was sighted on redd. Landed for substrate sample and found at least 3 coho in area. Substrate sample impossible due to water depth. Coho appeared to still be spawning. Water turbidity increased due to bank full conditions until survey not possible about 3 miles above Nyac. Areas 102 and 101 unsurveyable.													
10/14/85	Bear Creek	100						3	1	7	10	3	3	ADFG
	Lower 2 miles Nyac to Shamrock Creek unsurveyable due to turbidity caused by high water. Creek was bankfull but visibility improved as we proceeded upstream. Carcass was found above previous upper limit. Extension was confirmed by electrofishing on the 15 which took a 10 mm coho fry confirming extension of upper limit. Aerial survey not possible on 15th due to weather.													
10/14/85	Slate Creek	100						3	1	7	12	3	3	ADFG
	Live coho seen were heavily fungus. Creek was bank full. Suspect high water and bears reason for small numbers of carcasses.													
10/14/85	Granite Creek	100						3		7	5	3	3	ADFG
	Stream was surveyed twice upstream and down, only one coho was seen on second downstream pass. Creek was bankfull.													
7/7/86	Tuluksak	101	0	0	0	0	0			2	24	1	1	TDCo
7/7/86	Tuluksak	102	0	0	0	0	0			2	24	1	1	TDCo
	Douglas Weir is a consultant for Tuluksak Dredging Co. (TDCo) and has worked with the Deptartment since 1983 and his survey technique is the same as the departments KF (Ken Fleagle). Survey was from Nyac to Otter Creek.													
7/9/86	Tuluksak	101	0	0	0	0	0			2	24	1	1	TDCo
7/9/86	Tuluksak	102	0	0	0	0	0			2	24	1	1	TDCo
	Douglas Weir; see notes 7/7/86 survey													

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-2. Aerial surveys of the Tuluksak River and tributaries (continued).

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
7/28/86	Tuluksak	100	4	20						6	30		3	ADFG
7/28/86	Tuluksak	101	3	20						6	30		3	ADFG
	River very high, turbid, clearing in area 102. Ended at Nyac. Elapsed time 23 minutes.													
7/28/86	Tuluksak	102	1							6	30		3	ADFG
	River very high, turbid, clearing in area 102. Ended at Nyac. Elapsed time 23 minutes.													
8/2/86	Tuluksak	101	2	1			common			2	30	2	3	TDCo
8/2/86	Tuluksak	102	0	0	0	0	0			2	30	2	3	TDCo
8/2/86	Tuluksak	103	0	0	0	0	0			2	30	2	3	TDCo
	DW see 7/7/86 and 7/9/86 survey chum salmon carcasses were common, no count possible from Fog River to foothills													
8/2/86	Bear Creek	101	0	0	0	0	0			2	5	2	3	TDCo
	DW Douglas Weir see Tuluksak Survey 7/7/86													
8/3/86	Tuluksak	102	4	1	0	0	0			8		2	2	TDCo
	Count made on raft trip from Dugout Creek to Foothills. Based on DW's five years of work on Tuluksak River worst counting conditions encountered. Kings population less than 50 based on past years distribution, no chums above foothills in 1986													
7/28/87	Fog River	101	10			5				3	20	1	3	ADFG
	Surveyed from head waters to major fork below foothills.													
7/28/87	Tuluksak	101	60			258				3	36	1	3	ADFG
7/28/87	Tuluksak	102	15			5				3	36	1	3	ADFG
7/28/87	Tuluksak	103	7							3	36	1	3	ADFG
	Turbidity prevented survey below Otter Creek. Otter Creek to Nyac was difficult due to green water color obscuring deeper portions of stream. Water was high due to recent rains. Turbidity appeared to be natural, not from mine.													
8/1/87	Tuluksak	102	86			25				9	10	2	1	TDCo
	This survey was done by Doug Weir who has been the resident naturalist at Nyac for the preceding 10 years or so. He surveyed most of the small tailing streams. The counts were made from July 21 through August 1 so there is some chance of double counting.													
8/1/87	Bear Creek	101	3							9	3	2	1	NGDC

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-2. Aerial surveys of the Tuluksak River and tributaries (continued).

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
7/21/88	Tuluksak	102	57			210				11	7	2	1	BLM
	Upper Tuluksak river chinook salmon enhancement project report, 6/20 to 7/26, 14-15 September, 1988. Weir installed by BLM with ADFG advice and tech. assistance. Purpose to capture chinook for ripening and egg take to test feasibility of chinook enhancement. Weir and incubation techniques were tested. Some salmon passed before weir was installed; some after removal.													
7/28/88	Tuluksak	101	188	7	97	1,445	243			2F	59	3	2	ADFG
7/28/88	Tuluksak	102	0	0	0	0				2F	59	3	2	ADFG
	Slightly past peak of spawning. Survey began about 5 miles north of Nyac on Tuluksak area 102, ended 5 miles above Fog River. Water = 1 in upper end and 3 near Fog river. USFWS C-185 on floats.													
7/18/90	Tuluksak	101	954			1,610				F2	45	2	1	ADFG
7/18/90	Tuluksak	102	20			0				F2	45	2	1	ADFG
7/18/90	Tuluksak	101	193			1,634				F2	45	2	1	ADFG
	Water turbid for first 6 miles, good after that.													
7/18/90	Tuluksak	102	12			0				F2	45	2	1	ADFG
	Good survey; high confidence in numbers. Kings stood out very well in the clear water. Counted only the number of kings seen, did not make note of the number of redds. Most of the kings were paired or scattered.													
7/24/91	Tuluksak	101	342	2		1,314				F2	50	2	1	ADFG
7/24/91	Tuluksak	102	14							F2	50	2	1	ADFG
	Some glare when looking west, survey started at USFWS weir about 5 miles upstream of Fog River confluence.													
8/26/91	Tuluksak	101						121		F1	40	1	1	ADFG
	31 coho below weir, water from Fog River too weir too muddy to see fish.													
														0
9/3/91	Tuluksak	101						1,022		F1		1	1	ADFG
	Surveyed from Fog River to bridge at Nyac, 100 coho just below weir													
7/29/92	Tuluksak	101	190	1		2,024				1	25	2	3	ADFG
	Light very poor. Sun in and out of clouds. Chum salmon redds visible in many areas where fish were not visible. Overcast was 100% at Nyac so did not survey 102 and Bear Creek. Above weir 157 kings and 1989 chum.													

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-2. Aerial surveys of the Tuluksak River and tributaries (continued).

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
8/26/93	Tuluksak	101	0	0	1	0	0	845	0	1	40	1	3	ADFG
	River wasn't turbid but a dark green color that obscured water of deep and medium depth. Visibility improved upstream but only 2 cohos were seen above the foothills so did not survey the upper index areas since fish had not arrived there in numbers.													
7/26/94	Tuluksak	101	285			162				F1	15	2	3	ADFG
	Started at Nyac; conditions were perfect. At Otter Creek water turned bog brown. Only 14 kings were seen below Otter Creek. Tuluksak River was bank full and turbidity increased as we went downstream. Discontinued before we reached weir because visibility was hopeless.													
9/8/96	Tuluksak	101						859		2	40	1	1	ADFG
9/8/96	Tuluksak	102						41		2	40	1	1	ADFG
	Lower 1/2 of 101 poor visibility- turbid most of bottom not visible until about 5 miles above weir site.													
9/8/96	Tuluksak	101						897		2	40	1	1	ADFG
9/8/96	Tuluksak	102						17		2	40	1	1	ADFG
	Clear for lower half of 101, cloudy for rest of survey. Water too dirty to see bottom until about 5 miles above weir site.													
7/28/97	Tuluksak	101	173			990				3	50	2	2	ADFG
7/23/98	Tuluksak	101	230			610				6	40	2	2	ADFG
	Too turbid to see fish for about 10 miles above Fog river. Surveyed from Fog to Nyac													
7/28/02	Tuluksak	101	223	21	41	1,452	11			1	15	2	1	ADFG
	Incomplete survey. Index area 101 was not completed and pilot 'cut corners'.													
7/31/02	Tuluksak	101								1	2		3	ADFG
	Survey aborted after first 2 miles from stop point due to heavy turbulence. No salmon observed in short area surveyed.													
7/28/03	Tuluksak	101	78	11	25					1		2	2	ADFG
7/28/03	Tuluksak	102	5	0	2					1		2	2	ADFG
	Lower 7 miles of 101 not surveyable because of low light and slightly turbid water, however, the majority of the at 7 mile section was not good king spawning habitat, so few (if													

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-2. Aerial surveys of the Tuluksak River and tributaries (continued).

Date	Stream/notes	Card number	Live Chinook	Chinook carcass	Chinook redd	Live chum	Chum carcass	Live coho	Coho carcass	Survey method	Distance (miles)	Spawn stage	Rating	Agency
7/27/04	Tuluksak	101	1,191	5	60					1		2	2	ADFG
7/27/04	Tuluksak	102	0	0	0					1		2	2	ADFG
	Difficulty in making counts in the lower portion of 101 due to low water clarity. Missed a few sections of 101 due to how much it meandered. Most chinook observed in groups of 5 in the mid to upper portion of 101. Difficulty in counts in upper portion of 101 due to braided nature of the channel, some rippling in the area. Chum seen in sparse groups of 20 to 50. Started counts above weir. No fish observed in 102													
7/29/07	Tuluksak	101	166		17					1			2	ADFG
7/29/07	Tuluksak	102	7							1			2	ADFG
	Very few fish in area 102 but visibility was good. We flew the first 17 miles of 101, but after that the water became too turbid to differentiate species. Last 12 miles of index area were not flown.													
8/3/08	Tuluksak	101	192		13					1		2	3	ADFG
8/3/08	Tuluksak	102	2							1		2	3	ADFG
	Flew from the headwaters downstream. There were only 2 kings spotted in index area 102 where there is extensive mine tailings. The water quality degraded as we flew down stream and stopped surveying short of the mouth. This survey is rated poor and incomplete.													

Card 100 is the total for the survey. Survey methods; F: Float equipped, 1: PA-18 Super Cub, 2: C-185, 3: C-180, 6: Other fixed wing, 7: Helicopter, 8: Boat, 9: Foot, 11: Weir. Spawn stage; 1: Before peak, 2: At peak, 3: After peak. Ratings are on a scale of 1 (good) to 3 (poor).

Table A-3. Average daily water temperature (° C) along the Tuluksak River. HOBO temperature loggers were installed on the bottom of the river bed and recorded water temperature readings every five hours. The average daily temperature is displayed from each logger, designated by its site name and distance upstream from the weir. Twelve of the fifteen loggers deployed in 2002 were recovered in 2003. The logger from 62.5 rkm recorded one week of data, and is not included. 5Hab was deployed from a river boat trip, all other loggers were installed during a raft trip later in the season. Loggers 5Hab and 3A stopped recording partway through the winter.

	6E	6Hab	5Hab	4Camp2	3G	3C	3A	2Hab	2C	2A	1B
Date	5.5rkm	17.3 rkm	35.5 rkm	40.6 rkm	44.1 rkm	52.0 rkm	56.0 rkm	58.6 rkm	60.3 rkm	63.6 rkm	70.0 rkm
07/09/02			11.4								
07/10/02			11.7								
07/11/02			11.4								
07/12/02			11.5								
07/13/02			11.0								
07/14/02			10.5								
07/15/02			11.3								
07/16/02			11.8								
07/17/02			12.4								
07/18/02			14.4								
07/19/02			15.6								
07/20/02			19.6								
07/21/02			19.5								
07/22/02			22.5								
07/23/02			18.0								
07/24/02			14.7								
07/25/02			13.3								
07/26/02			13.3								
07/27/02			13.6								
07/28/02			16.8								
07/29/02			21.0								
07/30/02			20.9								
07/31/02			21.7								16.2
08/01/02			23.0							16.6	13.1
08/02/02			25.8					16.2	19.1	13.3	13.0
08/03/02			25.1				17.2	14.9	15.1	13.7	13.3
08/04/02			25.0				14.1	15.4	16.0	14.6	13.7
08/05/02			20.6			14.7	13.8	13.9	14.0	13.3	13.5
08/06/02			14.3	12.8	12.5	12.0	12.0	12.0	12.0	11.4	11.8
08/07/02			17.9	12.3	11.7	12.5	11.6	11.9	11.9	11.5	11.3
08/08/02			11.5	11.8	11.3	11.9	11.2	11.6	11.5	11.0	11.0

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
08/09/02	11.3	12.1	12.0	11.4	10.9	11.3	10.9	11.2	10.9	10.7	10.6
08/10/02	11.1	10.8	10.8	11.4	10.9	11.8	11.0	11.4	11.0	10.6	10.4
08/11/02	11.4	11.6	12.9	11.3	10.9	11.2	11.0	11.2	10.8	10.7	10.8
08/12/02	12.0	11.9	18.4	12.4	11.4	12.3	11.6	12.7	11.9	11.6	11.1
08/13/02	11.8	11.5	10.9	11.5	10.9	11.3	10.8	11.2	10.8	10.8	10.7
08/14/02	11.6	11.2	14.4	11.2	10.8	11.7	11.0	11.3	10.9	11.2	10.6
08/15/02	11.5	11.2	18.5	11.4	11.0	11.2	10.9	11.1	10.8	10.6	10.6
08/16/02	11.0	10.7	17.1	10.8	10.4	10.6	10.3	10.5	10.3	10.1	10.0
08/17/02	10.8	10.6	17.0	11.0	10.5	10.8	10.3	10.5	10.3	10.1	10.2
08/18/02	10.7	10.5	17.6	10.6	10.1	10.4	10.2	10.2	9.9	9.7	9.8
08/19/02	10.3	9.9	17.5	10.2	9.7	10.2	9.7	9.9	9.6	9.6	9.3
08/20/02	10.1	9.8	8.8	10.0	9.9	9.8	9.6	9.7	9.6	9.2	9.1
08/21/02	9.5	9.2	10.0	10.1	9.4	9.8	9.5	10.1	9.2	9.2	9.0
08/22/02	10.3	10.3	15.7	10.6	10.2	10.5	10.2	11.0	10.2	9.9	9.7
08/23/02	10.9	10.6	17.4	11.0	10.7	10.9	10.4	10.4	10.2	9.7	9.8
08/24/02	11.1	10.8	16.6	10.3	10.2	10.3	10.0	9.9	9.9	9.4	9.4
08/25/02	10.8	10.6	18.0	10.9	10.4	10.9	10.0	10.7	10.3	9.6	9.3
08/26/02	11.5	11.0	19.5	10.5	10.2	10.6	9.9	10.6	10.5	9.7	9.2
08/27/02	11.1	10.7	20.5	10.4	10.0	10.8	9.8	10.0	9.9	9.5	9.2
08/28/02	10.8	10.4	19.8	10.1	9.8	9.8	9.6	9.8	9.6	9.3	9.1
08/29/02	10.0	9.8	18.7	9.6	9.4	9.7	9.4	9.4	9.2	9.0	8.8
08/30/02	10.3	10.0	18.2	10.0	9.6	9.9	9.4	9.6	9.4	9.2	8.9
08/31/02	10.3	9.9	17.7	9.8	9.6	9.5	9.2	9.5	9.1	8.9	8.8
09/01/02	10.0	9.7	15.0	9.7	9.3	9.8	9.2	9.4	9.1	8.8	8.8
09/02/02	9.5	9.1	13.5	9.4	9.0	9.5	8.7	9.4	8.8	8.6	8.3
09/03/02	9.0	8.9	12.4	9.0	8.6	8.8	8.6	8.8	8.4	8.1	8.1
09/04/02	9.8	9.6	12.7	9.6	9.6	9.5	9.3	9.4	9.3	9.0	9.0
09/05/02	10.1	9.9	18.3	9.9	9.7	9.6	9.5	9.5	9.3	9.2	8.9
09/06/02	10.0	9.6	18.6	9.6	9.3	9.3	9.2	9.2	9.0	8.8	8.6
09/07/02	9.6	9.3	17.4	9.1	8.9	8.8	8.7	8.9	8.9	8.3	8.3
09/08/02	9.3	9.1	18.8	8.9	8.6	8.9	8.4	8.5	8.6	7.8	8.0
09/09/02	8.7	8.4	17.2	8.3	8.0	7.8	7.6	8.1	8.0	7.3	7.3
09/10/02	8.2	7.8	16.3	7.6	7.6	7.5	7.3	7.4	7.3	6.8	6.9
09/12/02	8.1	7.8	17.4	7.7	7.6	7.4	7.3	7.3	7.3	7.1	7.0
09/11/02	8.0	8.0	17.7	7.6	7.6	7.7	7.4	7.3	7.3	7.1	7.1

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
09/13/02	8.3	8.0	15.2	7.8	7.8	7.7	7.5	7.5	7.5	7.1	7.2
09/14/02	8.0	7.9	14.3	7.5	7.3	7.2	7.0	7.0	7.0	6.6	6.6
09/15/02	7.4	7.2	14.6	6.9	6.8	7.0	6.6	6.8	6.7	6.4	6.4
09/16/02	6.7	6.5	18.6	6.3	6.0	6.0	5.7	5.9	5.7	5.4	5.3
09/17/02	6.7	6.3	19.0	6.4	6.4	6.6	6.1	6.6	6.3	5.9	5.8
09/18/02	6.3	6.3	18.1	6.2	6.0	6.0	5.9	5.9	5.9	5.3	5.4
09/19/02	5.7	5.4	18.0	5.5	5.4	5.5	5.2	5.2	5.2	4.9	4.8
09/20/02	5.0	4.8	18.0	4.9	4.9	4.9	4.5	4.8	4.7	4.3	4.3
09/21/02	4.7	4.7	16.2	4.8	4.8	5.2	4.7	4.8	4.8	4.5	4.3
09/22/02	5.0	4.8	17.1	5.1	5.0	5.0	4.8	4.8	4.8	4.7	4.5
09/23/02	6.2	5.9	19.3	6.4	6.3	6.4	6.1	6.1	6.1	5.9	5.7
09/24/02	7.2	7.0	19.1	7.1	7.0	7.1	6.7	6.7	6.7	6.4	6.4
09/25/02	7.5	7.2	19.6	7.1	7.2	6.9	6.9	6.8	6.9	6.5	6.5
09/26/02	7.2	7.1	19.1	7.0	7.0	7.1	6.9	6.8	6.9	6.4	6.4
09/27/02	7.5	7.2	18.4	7.1	7.0	6.9	6.8	6.8	6.7	6.4	6.2
09/28/02	7.3	7.1	17.7	6.8	6.6	6.6	6.4	6.4	6.4	6.1	6.0
09/29/02	7.1	6.8	18.8	6.4	6.5	6.2	6.0	6.0	6.0	6.0	5.9
09/30/02	6.6	6.3	18.0	6.0	5.9	5.9	5.6	5.6	5.7	5.4	5.4
10/01/02	6.3	6.0	16.9	5.8	5.6	5.8	5.3	5.3	5.3	5.2	5.1
10/02/02	5.1	4.8	17.7	4.7	4.5	4.6	4.2	4.3	4.3	4.1	4.1
10/03/02	4.4	4.3	17.2	4.3	4.1	4.2	3.9	3.9	3.9	3.9	3.8
10/04/02	3.8	3.8	18.7	3.9	3.9	3.8	3.6	3.7	3.8	3.6	3.3
10/05/02	3.6	3.5	18.0	3.8	3.7	3.5	3.5	3.5	3.5	3.5	3.3
10/06/02	3.9	3.9	17.0	4.0	3.9	3.7	3.7	3.7	3.7	3.7	3.4
10/07/02	4.7	4.7	18.2	4.6	4.6	4.5	4.5	4.5	4.5	4.1	4.1
10/08/02	4.2	3.9	17.1	3.9	3.6	3.6	3.5	3.4	3.5	3.4	3.3
10/09/02	3.3	3.2	18.0	3.3	3.3	3.3	3.2	3.1	3.2	3.2	2.8
10/10/02	3.6	3.5	20.9	3.9	3.7	3.7	3.6	3.6	3.6	3.4	3.3
10/11/02	4.9	4.8	19.8	4.9	4.7	5.0	4.6	4.7	4.7	4.4	4.3
10/12/02	5.2	4.9	19.9	4.8	4.8	4.8	4.6	4.5	4.7	4.4	4.3
10/13/02	5.3	5.2	20.4	5.3	5.2	5.3	5.3	5.3	5.3	5.0	4.8
10/14/02	5.5	5.2	21.2	5.1	5.2	5.1	5.0	5.0	5.1	4.7	4.6
10/15/02	4.9	4.7	19.3	4.7	4.7	4.6	4.6	4.5	4.6	4.2	4.2
10/16/02	4.4	4.1	19.0	4.0	4.0	4.0	3.9	3.7	3.9	3.6	3.5
10/17/02	2.7	2.6	20.1	2.8	2.7	2.7		2.4	2.6	2.5	2.4

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
10/18/02	2.1	2.2	19.8	2.7	2.9	2.9		2.9	3.1	2.7	2.7
10/19/02	0.6	0.5	19.1	0.6	1.1	0.8		0.9	0.9	1.0	0.8
10/20/02	-0.1	-0.1	18.0	-0.1	-0.1	-0.2		-0.1	-0.1	0.0	-0.1
10/21/02	-0.1	-0.1	17.3	0.1	0.2	0.3		0.2	0.2	0.3	0.2
10/22/02	0.7	0.9	16.9	1.6	2.0	1.9		1.9	1.9	1.8	1.7
10/23/02	1.7	1.7	16.6	1.9	2.0	2.0		1.9	1.9	2.0	1.8
10/24/02	1.9	1.8	17.0	2.2	2.2	2.1		2.1	2.1	2.1	1.8
10/25/02	2.5	2.4	17.1	2.6	2.6	2.6		2.5	2.5	2.4	2.2
10/26/02	2.7	2.5	17.0	2.7	2.6	2.5		2.5	2.5	2.4	2.2
10/27/02	2.3	2.3	19.2	2.5	2.4	2.4		2.4	2.4	2.1	2.1
10/28/02	1.9	1.9	18.1	2.0	2.1	1.9		2.0	2.0	2.1	1.7
10/29/02	2.7	2.6	20.7	3.1	3.3	3.2		3.2	3.2	3.2	2.9
10/30/02	3.6	3.5	20.4	3.6	3.7	3.5		3.4	3.5	3.4	3.3
10/31/02	3.3	3.1	19.8	3.4	3.5	3.2		3.1	3.1	3.0	2.9
11/01/02	2.8	2.5	19.3	2.5	2.8	2.7		2.7	2.7	2.6	2.3
11/02/02	2.1	2.0	19.1	1.9	1.8	1.9		1.7	1.8	1.6	1.7
11/03/02	1.0	0.9	19.2	1.5	1.6	1.6		1.5	1.6	1.7	1.5
11/04/02	2.2	2.3	17.6	2.9	2.8	2.8		2.7	2.8	2.6	2.5
11/05/02	3.3	3.3	18.7	3.3	3.5	3.5		3.5	3.5	3.5	3.2
11/06/02	3.5	3.5	20.0	3.8	3.8	3.8		3.6	3.6	3.4	3.4
11/07/02	3.2	3.3	19.3	2.7	3.0	2.9		2.9	2.9	2.6	2.7
11/08/02	1.6	1.6	19.1	0.2	1.5	1.3		1.5	1.5	1.4	1.5
11/09/02	0.0	0.0	19.0	-0.6	0.1	-0.3		0.0	0.0	0.0	-0.1
11/10/02	-0.1	-0.1	20.9	-1.3	-0.1	-0.5		-0.1	-0.4	-0.1	-0.5
11/11/02	-0.1	-0.1	19.2	-3.7	-0.1	-0.5		-0.1	-0.1	-0.1	-0.5
11/12/02	-0.1	-0.1	19.7	-2.9	-0.1	-0.5		-0.1	-0.1	-0.1	-0.5
11/13/02	-0.1	-0.1	18.2	-5.1	-0.1	-0.5		-0.1	-0.3	-0.1	-0.6
11/14/02	-0.1	-0.1	18.8	-4.4	-0.1	-0.5		-0.1	-0.2	-0.1	-0.6
11/15/02	-0.1	-0.1	18.1	-4.7	-0.1	-0.5		-0.1	-0.3	-0.1	-0.6
11/16/02	-0.1	-0.1	19.7	-1.7	-0.1	-0.2		-0.1	-0.1	-0.1	-0.6
11/17/02	-0.1	-0.1	17.9	-1.5	-0.1	-0.1		-0.1	-0.1	-0.1	-0.6
11/18/02	-0.1	-0.1	18.2	-2.2	-0.1	-0.4		-0.1	-0.1	-0.1	-0.5
11/19/02	-0.1	-0.1	18.2	-3.7	-0.1	-0.1		-0.1	-0.1	-0.1	-0.3
11/20/02	-0.1	-0.1	18.6	-2.4	-0.1	0.0		0.0	-0.1	0.0	-0.4
11/21/02	-0.1	-0.1	19.4	-3.2	-0.1	-0.1		-0.1	-0.1	0.0	-0.2

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
11/22/02	-0.1	-0.1	21.5	-1.4	0.1	0.0		0.0	0.0	0.0	-0.1
11/23/02	-0.1	-0.1	21.3	-0.4	0.5	0.2		0.1	0.1	0.4	0.0
11/24/02	-0.1	-0.1	20.9	-2.3	0.0	-0.1		0.0	0.0	0.0	-0.2
11/25/02	-0.1	-0.1	21.1	-2.3	0.2	0.1		0.1	0.1	0.1	0.0
11/26/02	-0.1	-0.1	21.3	-1.1	0.4	0.2		0.1	0.1	0.1	0.1
11/27/02	-0.1	-0.1	21.3	-0.8	0.2	0.1		0.1	0.1	0.1	0.0
11/28/02	-0.1	-0.1	20.9	-0.8	0.2	0.1		0.1	0.1	0.1	-0.1
11/29/02	-0.1	-0.1	21.1	-0.6	0.3	0.2		0.1	0.1	0.1	0.1
11/30/02	-0.1	-0.1	21.4	-0.8	0.0	-0.3		-0.1	-0.4	-0.1	-0.4
12/01/02	-0.1	-0.1	21.3	-1.3	-0.1	-0.5		-0.1	-0.3	-0.1	-0.6
12/02/02	-0.1	-0.1	21.2	-0.8	-0.1	-0.2		-0.1	-0.1	0.0	-0.4
12/03/02	-0.1	-0.1	21.4	-0.6	0.3	0.2		0.3	0.4	0.5	0.3
12/04/02	-0.1	-0.1	21.3	-0.6	0.6	0.3		0.3	0.4	0.4	0.2
12/05/02	-0.1	-0.1	21.2	-0.6	1.2	1.0		0.9	1.0	1.0	0.9
12/06/02	-0.1	0.2	21.3	-0.5	1.1	0.9		0.9	0.9	0.9	0.8
12/07/02	-0.1	0.1	20.9	-1.8	0.3	0.2		0.1	0.1	0.1	0.0
12/08/02	-0.1	0.1	20.9	-1.6	0.6	0.3		0.3	0.5	0.5	0.3
12/09/02	-0.1	0.9	21.2	-0.7	1.1	1.0		0.9	1.0	0.9	0.9
12/10/02	-0.1	0.4	21.2	-2.8	0.4	0.0		0.1	0.1	0.1	-0.1
12/11/02	-0.1	-0.1	21.5	-6.1	-0.1	-3.1		-0.1	-0.5	-0.1	-0.5
12/12/02	-0.1	-0.1	21.4	-6.7	-0.1	-3.9		-0.1	-0.5	-0.1	-0.5
12/13/02	-0.1	-0.1	21.7	-3.3	-0.1	-1.5		-0.1	-0.1	-0.1	-0.6
12/14/02	-0.1	-0.1	21.5	-3.5	-0.1	-2.9		-0.1	-0.2	-0.1	-0.6
12/15/02	-0.1	-0.1	21.3	-3.7	-0.1	-1.6		-0.1	-0.1	-0.1	-0.6
12/16/02	-0.1	-0.1	21.6	-2.6	-0.1	-1.0		-0.1	-0.1	-0.2	-0.6
12/17/02	-0.1	-0.1	21.5	-2.9	-0.1	-2.4		-0.1	-0.4	-0.1	-0.6
12/18/02	-0.1	-0.1	21.5	-4.3	-0.1	-3.5		-0.1	-0.3	-0.2	-0.6
12/19/02	-0.1	-0.1	21.6	-3.8	-0.1	-1.6		-0.1	-0.1	-0.1	-0.6
12/20/02	-0.1	-0.1	21.5	-2.4	-0.1	-0.9		-0.1	-0.1	-0.1	-0.6
12/21/02	-0.1	-0.1	21.9	-2.6	-0.1	-1.8		-0.1	-0.1	-0.1	-0.6
12/22/02	-0.1	-0.1	22.0	-3.8	-0.1	-4.1		-0.1	-0.2	-0.1	-0.5
12/23/02	-0.1	-0.1	21.5	-3.8	-0.1	-2.3		-0.1	-0.1	-0.1	-0.5
12/24/02	-0.1	-0.1	21.6	-3.3	-0.1	-1.9		-0.1	-0.1	-0.1	-0.5
12/25/02	-0.1	-0.1	22.1	-3.3	-0.1	-2.1		-0.1	-0.2	-0.1	-0.5
12/26/02	-0.1	-0.1	21.9	-3.3	-0.1	-2.3		-0.1	-0.2	-0.1	-0.6

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
12/27/02	-0.1	-0.1	21.5	-3.5	-0.1	-2.3		-0.1	-0.2	-0.1	-0.6
12/28/02	-0.1	-0.1	22.0	-4.6	-0.1	-3.5		-0.1	-0.4	-0.1	-0.6
12/29/02	-0.1	-0.1	22.2	-4.8	-0.1	-3.1		-0.1	-0.3	-0.1	-0.6
12/30/02	-0.1	-0.1	21.8	-5.3	-0.1	-1.0		-0.1	-0.5	-0.1	-0.6
12/31/02	-0.1	-0.1	21.9	-5.8	-0.1	-0.5		-0.1	-0.5	-0.1	-0.6
01/01/03	-0.1	-0.1	21.7	-6.2	-0.1	-5.0		-0.1	-0.5	-0.1	-0.6
01/02/03	-0.1	-0.1	21.5	-5.9	-0.1	-7.2		-0.1	-0.3	-0.1	-0.6
01/03/03	-0.1	-0.1	21.4	-4.6	-0.1	-3.6		-0.1	-0.2	-0.1	-0.6
01/04/03	-0.1	-0.1	21.8	-3.7	-0.1	-2.0		-0.1	-0.3	-0.1	-0.6
01/05/03	-0.1	-0.1	21.6	-3.3	-0.1	-2.3		-0.1	-0.5	-0.1	-0.6
01/06/03	-0.1	-0.1	21.8	-3.6	-0.1	-2.7		-0.1	-0.6	-0.1	-0.6
01/07/03	-0.1	-0.1	21.6	-4.2	-0.1	-3.4		-0.1	-0.5	-0.1	-0.6
01/08/03	-0.1	-0.1	21.4	-3.4	-0.1	-1.9		-0.1	-0.2	-0.1	-0.6
01/09/03	-0.1	-0.1	21.7	-2.0	-0.1	-0.8		-0.1	-0.1	-0.1	-0.6
01/10/03	-0.1	-0.1	21.4	-1.2	-0.1	-0.6		-0.1	-0.1	-0.1	-0.6
01/11/03	-0.1	-0.1	21.5	-1.2	-0.1	-0.6		-0.1	-0.1	-0.1	-0.6
01/12/03	-0.1	-0.1	21.4	-1.4	-0.1	-1.1		-0.1	-0.1	-0.1	-0.6
01/13/03	-0.1	-0.1	21.6	-1.7	-0.1	-2.1		-0.1	-0.1	-0.1	-0.6
01/14/03	-0.1	-0.1	21.4	-2.4	-0.1	-2.9		-0.1	-0.1	-0.1	-0.6
01/15/03	-0.1	-0.1	21.1	-2.4	-0.1	-2.8		-0.1	-0.1	-0.1	-0.6
01/16/03	-0.1	-0.1	21.6	-2.3	-0.1	-1.8		-0.1	-0.1	-0.1	-0.6
01/17/03	-0.1	-0.1	21.8	-2.2	-0.1	-2.3		-0.1	-0.1	0.0	-0.6
01/18/03	-0.1	-0.1	21.7	-1.9	-0.1	-1.9		-0.1	-0.1	-0.1	-0.6
01/19/03	-0.1	-0.1	21.3	-2.1	-0.1	-2.4		-0.1	-0.1	-0.1	-0.6
01/20/03	-0.1	-0.1	21.5	-1.9	-0.1	-2.4		-0.1	0.0	-0.1	-0.6
01/21/03	-0.1	-0.1	21.5	-2.2	-0.1	-2.4		-0.1	-0.2	0.0	-0.6
01/22/03	-0.1	-0.1	21.5	-2.9	-0.1	-2.2		-0.1	-0.5	0.0	-0.6
01/23/03	-0.1	-0.1	21.5	-3.6	-0.1	-0.5		-0.1	-0.4	-0.1	-0.6
01/24/03	-0.1	-0.1	21.5	-4.0	-0.1	-2.5		-0.1	-0.4	-0.1	-0.6
01/25/03	-0.1	-0.1	21.7	-4.2	-0.1	-4.6		-0.1	-0.3	0.0	-0.6
01/26/03	-0.1	-0.1	21.9	-4.3	-0.1	-5.6		-0.1	-0.5	0.0	-0.6
01/27/03	-0.1	-0.1	21.9	-4.4	-0.1	-2.1		-0.1	-0.3	0.0	-0.6
01/28/03	-0.1	-0.1	21.8	-3.5	-0.1	-0.7		-0.1	-0.1	-0.1	-0.6
01/29/03	-0.1	-0.1	21.9	-3.3	-0.1	-2.7		-0.1	-0.2	-0.1	-0.6
01/30/03	-0.1	-0.1	21.8	-3.3	-0.1	-4.7		-0.1	-0.3	0.0	-0.6

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
01/31/03	-0.1	-0.1	21.9	-3.5	-0.1	-4.6		-0.1	-0.1	0.0	-0.6
02/01/03	-0.1	-0.1	21.5	-3.3	-0.1	-4.0		-0.1	0.0	0.0	-0.6
02/02/03	-0.1	-0.1	21.5	-3.3	-0.1	-4.5		-0.1	-0.2	-0.1	-0.6
02/03/03	-0.1	-0.1	21.7	-2.6	-0.1	-3.0		-0.1	-0.1	-0.1	-0.6
02/04/03	-0.1	-0.1	21.8	-1.2	-0.1	-1.6		-0.1	0.0	-0.1	-0.5
02/05/03	-0.1	-0.1	21.9	-0.6	-0.1	-1.3		-0.1	0.0	0.0	-0.6
02/06/03	-0.1	-0.1	21.9	-1.2	-0.1	-2.2		-0.1	-0.2	0.0	-0.6
02/07/03	-0.1	-0.1	21.5	-1.0	-0.1	-1.5		-0.1	-0.1	-0.1	-0.6
02/08/03	-0.1	-0.1	21.2	-0.5	-0.1	-0.4		-0.1	0.0	0.0	-0.5
02/09/03	-0.1	-0.1	21.5	-0.5	-0.1	-0.5		-0.1	-0.1	-0.1	-0.6
02/10/03	-0.1	-0.1	21.5	-0.5	-0.1	-0.4		-0.1	0.0	0.0	-0.5
02/11/03	-0.1	-0.1	21.3	-0.4	-0.1	-0.4		-0.1	-0.1	0.0	-0.6
02/12/03	-0.1	-0.1	21.0	-2.2	-0.1	-2.1		-0.1	-0.3	-0.1	-0.6
02/13/03	-0.1	-0.1	21.1	-3.4	-0.1	-4.1		-0.1	-0.4	-0.1	-0.6
02/14/03	-0.1	-0.1	20.9	-2.4	-0.1	-3.1		0.0	-0.2	0.0	-0.5
02/15/03	-0.1	-0.1		-2.4	-0.1	-2.5		0.1	-0.3	0.1	-0.6
02/16/03	-0.1	-0.1		-3.6	-0.1	-4.1		0.0	-0.4	0.1	-0.6
02/17/03	-0.1	-0.1		-4.7	-0.1	-5.7		0.0	-0.3	0.1	-0.6
02/18/03	-0.1	-0.1		-5.3	-0.1	-6.1		0.1	-0.2	0.0	-0.6
02/19/03	-0.1	-0.1		-4.9	-0.1	-3.5		0.1	-0.3	0.0	-0.5
02/20/03	-0.1	-0.1		-4.4	-0.1	-2.0		0.1	0.1	0.1	-0.6
02/21/03	-0.1	-0.1		-4.0	-0.1	-2.9		0.0	-0.1	0.1	-0.5
02/22/03	-0.1	-0.1		-3.1	-0.1	-2.3		-0.1	0.0	0.0	-0.5
02/23/03	-0.1	-0.1		-2.4	-0.1	-2.0		-0.1	-0.1	-0.2	-0.6
02/24/03	-0.1	-0.1		-1.2	-0.1	-0.6		0.1	0.1	0.1	-0.5
02/25/03	-0.1	-0.1		-0.7	-0.1	-0.4		0.0	0.0	0.6	-0.5
02/26/03	-0.1	-0.1		-0.3	-0.1	-0.3		0.0	0.1	0.3	-0.5
02/27/03	-0.1	-0.1		0.0	-0.1	-0.3		0.0	-0.1	0.0	-0.5
02/28/03	-0.1	-0.1		0.0	-0.1	-0.3		0.0	0.0	0.0	-0.4
03/01/03	-0.1	-0.1		0.1	-0.1	-0.3		-0.1	0.0	0.0	-0.6
03/02/03	-0.1	-0.1		0.1	-0.1	-0.3		0.1	0.3	0.1	-0.5
03/03/03	-0.1	-0.1		0.0	-0.1	-0.4		-0.1	0.0	-0.1	-0.6
03/04/03	-0.1	-0.1		-1.3	-0.1	-0.8		-0.1	-0.4	-0.1	-0.6
03/05/03	-0.1	-0.1		-3.8	-0.1	-2.7		0.1	-0.3	0.2	-0.6
03/06/03	-0.1	-0.1		-5.2	-0.1	-4.6		0.1	-0.2	0.0	-0.6

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
03/07/03	-0.1	-0.1		-5.2	-0.1	-4.1		0.1	0.4	0.3	-0.6
03/08/03	-0.1	-0.1		-6.0	-0.1	-4.4		0.0	0.3	0.6	-0.5
03/09/03	-0.1	-0.1		-6.8	-0.1	-5.1		0.0	0.4	0.4	-0.4
03/10/03	-0.1	-0.1		-7.1	-0.1	-5.4		0.1	0.2	0.0	-0.6
03/11/03	-0.1	-0.1		-8.1	-0.1	-6.2		0.1	0.3	0.4	-0.5
03/12/03	-0.1	-0.1		-9.1	-0.1	-6.8		0.1	0.7	0.6	-0.5
03/13/03	-0.1	-0.1		-12.3	-0.1	-9.9		0.0	0.7	0.6	-0.6
03/14/03	-0.1	-0.1		-14.1	-0.1	-11.8		0.0	0.7	0.5	-0.5
03/15/03	-0.1	-0.1		-13.2	-0.1	-12.0		0.0	0.8	0.1	-0.5
03/16/03	-0.1	-0.1		-12.4	-0.1	-11.5		0.1	0.8	0.2	-0.5
03/17/03	-0.1	-0.1		-13.1	-0.1	-11.0		0.0	1.0	0.3	-0.5
03/18/03	-0.1	-0.1		-13.4	-0.1	-11.7		0.0	1.0	0.2	-0.5
03/19/03	-0.1	-0.1		-13.6	-0.1	-12.3		-0.1	-0.2	0.0	-0.4
03/20/03	-0.1	-0.1		-11.8	-0.1	-11.3		-0.1	-0.4	-0.1	-0.6
03/21/03	-0.1	-0.1		-8.9	-0.1	-9.3		-0.1	-0.7	0.0	-0.6
03/22/03	-0.1	-0.1		-8.1	-0.1	-8.2		-0.1	0.0	0.3	-0.6
03/23/03	-0.1	-0.1		-7.3	-0.1	-7.8		-0.1	0.1	0.4	-0.6
03/24/03	-0.1	-0.1		-7.1	-0.1	-7.3		0.0	0.3	0.3	-0.6
03/25/03	-0.1	-0.1		-6.6	-0.1	-6.9		0.0	0.0	0.0	-0.5
03/26/03	-0.1	-0.1		-6.7	-0.1	-7.1		0.1	-0.1	0.5	-0.6
03/27/03	-0.1	-0.1		-6.9	-0.1	-7.1		0.1	0.2	0.6	-0.6
03/28/03	-0.1	-0.1		-6.0	-0.1	-6.7		0.0	-0.1	0.2	-0.6
03/29/03	-0.1	-0.1		-4.3	-0.1	-5.0		-0.1	-0.1	0.0	-0.6
03/30/03	-0.1	-0.1		-3.5	-0.1	-4.1		-0.1	0.0	0.1	-0.6
03/31/03	-0.1	-0.1		-3.7	-0.1	-4.2		-0.1	-0.1	0.0	-0.5
04/01/03	-0.1	-0.1		-2.2	-0.1	-3.2		-0.1	0.0	0.1	-0.6
04/02/03	-0.1	-0.1		-1.0	-0.1	-2.1		-0.1	0.0	0.1	-0.6
04/03/03	-0.1	-0.1		-1.2	-0.1	-1.5		-0.1	0.2	0.6	-0.6
04/04/03	-0.1	-0.1		-1.2	-0.1	-1.4		-0.1	0.0	0.4	-0.5
04/05/03	-0.1	-0.1		-0.9	-0.1	-1.2		0.0	0.3	0.6	-0.6
04/06/03	-0.1	-0.1		-0.9	-0.1	-1.3		0.1	1.2	0.6	-0.5
04/07/03	-0.1	-0.1		-2.1	-0.1	-1.8		0.4	0.6	0.7	-0.5
04/08/03	-0.1	-0.1		-2.5	-0.1	-2.4		0.4	0.6	0.6	-0.6
04/09/03	-0.1	-0.1		-2.3	-0.1	-2.2		0.3	2.6	0.5	-0.6
04/10/03	-0.1	-0.1		-1.0	-0.1	-0.7		0.6	2.7	0.7	-0.5

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
04/11/03	-0.1	-0.1		-0.5	-0.1	0.1		0.2	0.8	0.2	-0.5
04/12/03	-0.1	-0.1		0.0	-0.1	0.1		0.2	1.2	0.2	-0.4
04/13/03	-0.1	-0.1		0.5	-0.1	0.1		-0.1	-0.3	0.0	-0.6
04/14/03	-0.1	-0.1		0.5	-0.1	-0.2		-0.1	-0.1	0.0	-0.6
04/15/03	-0.1	-0.1		1.1	-0.1	0.0		-0.1	0.0	-0.2	-0.6
04/16/03	-0.1	-0.1		-0.2	-0.1	-0.3		0.0	-0.2	-0.4	-0.6
04/17/03	-0.1	-0.1		-0.3	0.0	-0.2		0.5	0.9	0.1	-0.6
04/18/03	-0.1	-0.1		-0.1	0.0	0.0		0.4	0.9	0.4	-0.5
04/19/03	-0.1	-0.1		-0.7	0.0	-0.6		0.2	0.5	0.0	-0.5
04/20/03	-0.1	-0.1		2.1	0.1	0.5		0.1	1.0	-0.2	-0.4
04/21/03	-0.1	-0.1		2.3	0.4	0.6		0.1	0.9	0.2	-0.4
04/22/03	0.0	-0.1		3.9	0.4	1.1		0.0	0.9	0.2	-0.4
04/23/03	0.0	-0.1		7.5	0.2	0.3		0.1	0.5	0.2	-0.5
04/24/03	-0.1	0.0		5.0	0.0	0.1		-0.1	-0.1	-0.1	-0.6
04/25/03	0.3	0.3		0.3	0.0	0.1		-0.1	-0.2	-0.1	-0.6
04/26/03	1.1	0.9		2.1	0.4	0.9		0.3	0.7	0.7	-0.6
04/27/03	1.9	1.4		4.9	0.7	1.3		0.4	0.4	0.3	-0.4
04/28/03	2.5	2.0		5.5	0.9	1.5		0.5	0.6	0.5	0.4
04/29/03	2.7	2.2		8.0	1.6	6.4		1.7	1.5	1.5	1.1
04/30/03	4.7	3.9		11.4	3.2	5.7		3.4	3.1	3.0	2.4
05/01/03	5.1	4.4		5.8	2.7	3.1		2.5	2.5	1.9	1.8
05/02/03	4.9	4.4		11.4	3.7	5.5		3.9	3.9	3.5	2.9
05/03/03	6.2	5.7		6.9	4.4	5.4		4.3	4.3	4.1	3.4
05/04/03	5.4	4.8		7.3	3.6	4.1		3.2	3.2	3.0	2.8
05/05/03	4.2	3.6		8.5	2.8	5.5		3.1	2.9	2.8	2.9
05/06/03	4.3	3.8		6.7	3.1	5.5		3.6	3.3	3.2	3.1
05/07/03	4.8	4.4		6.8	3.8	5.7		3.7	3.6	3.4	3.5
05/08/03	4.8	4.5		6.9	3.8	6.2		3.9	3.7	3.7	3.7
05/09/03	4.9	4.4		7.1	3.7	4.3		3.7	3.5	3.4	3.3
05/10/03	4.2	3.7		4.2	2.9	3.3		2.8	2.8	2.7	2.7
05/11/03	3.4	3.1		4.9	2.6	3.7		2.8	2.7	2.4	2.8
05/12/03	4.0	3.5		4.4	2.9	3.5		2.8	2.7	2.7	2.8
05/13/03	3.9	3.4		4.2	2.6	3.1		2.7	2.7	2.6	2.8
05/14/03	2.7	2.2		2.0	2.1	2.3		2.0	1.9	2.1	2.1
05/15/03	2.1	1.6		3.2	1.8	2.5		1.9	1.8	1.8	2.1

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
05/16/03	3.4	2.9		11.3	3.2	8.1		3.8	3.7	4.3	3.7
05/17/03	5.9	5.6		10.7	5.1	10.3		5.6	5.3	5.1	5.0
05/18/03	7.3	7.0		12.2	6.2	13.4		6.6	6.4	6.1	6.2
05/19/03	8.9	8.4		21.3	7.2	13.6		7.5	7.3	7.6	7.3
05/20/03	9.7	8.9		17.6	7.5	9.5		7.7	7.6	7.5	7.5
05/21/03	9.4	8.8		13.8	7.0	9.0		7.6	7.5	7.7	7.6
05/22/03	8.3	7.6		7.1	6.2	6.6		6.1	6.0	6.2	6.1
05/23/03	6.9	6.4		10.6	5.9	8.0		6.3	6.2	6.3	6.2
05/24/03	8.0	7.6		16.8	6.6	10.9		6.7	6.8	6.8	6.9
05/25/03	7.9	7.4		10.6	6.3	9.4		6.5	6.4	6.1	6.7
05/26/03	6.4	6.1		6.4	4.9	5.8		5.3	5.3	4.9	5.5
05/27/03	6.1	5.7		8.3	4.9	5.5		4.9	4.9	4.6	4.8
05/28/03	6.6	6.2		8.4	5.7	6.8		5.9	6.0	5.7	5.9
05/29/03	9.1	8.8		14.9	7.7	9.4		7.6	8.0	7.6	7.8
05/30/03	9.6	8.7		10.3	7.9	8.3		7.6	8.0	7.2	7.4
05/31/03	9.7	9.1		9.9	7.7	9.0		7.8	8.3	7.9	7.6
06/01/03	9.7	9.2		10.7	8.3	9.2		8.0	8.3	7.6	7.6
06/02/03	10.3	9.8		10.8	8.4	9.4		8.3	8.7	8.0	8.0
06/03/03	10.6	10.0		12.8	9.0	9.5		8.6	8.8	8.3	8.3
06/04/03	10.4	9.7		14.4	9.0	10.4		8.8	9.2	9.1	8.8
06/05/03	10.6	10.1		11.8	8.6	9.3		8.6	8.8	8.2	8.4
06/06/03	9.6	8.8		9.9	7.7	8.4		7.8	8.0	7.9	7.6
06/07/03	9.4	8.8		14.5	8.2	9.5		8.1	8.2	7.7	8.1
06/08/03	9.9	9.5		18.1	8.9	10.3		9.0	9.0	8.8	8.9
06/09/03	10.1	9.7		14.1	8.8	9.6		8.8	8.7	8.4	8.5
06/10/03	10.3	9.9		16.7	9.4	11.1		9.4	9.4	9.1	9.2
06/11/03	10.9	10.4		15.3	9.4	10.1		9.2	9.3	9.0	9.0
06/12/03	11.4	10.7		19.4	9.5	10.4		9.7	9.7	9.7	9.4
06/13/03	12.0	11.5		22.0	10.7	12.6		10.7	10.7	10.5	10.6
06/14/03	13.0	12.3		24.0	11.4	13.4		11.5	11.5	11.5	11.6
06/15/03	14.0	13.3		23.9	11.9	14.9		12.3	12.2	12.8	12.0
06/16/03	13.7	12.8		16.1	11.2	12.9		11.1	11.0	10.8	11.0
06/17/03	11.8	11.2		17.9	10.6	14.0		10.9	10.9	10.9	10.7
06/18/03	12.3	11.8		19.8	10.8	15.7		10.9	10.8	10.6	10.8
06/19/03	11.3	11.0		12.6	9.6	10.4		9.6	9.6	8.9	9.2

Table A-3. Average daily water temperature (°C) along the Tuluksak River (continued).

Date	6E 5.5rkm	6Hab 17.3 rkm	5Hab 35.5 rkm	4Camp2 40.6 rkm	3G 44.1 rkm	3C 52 rkm	3A 56 rkm	2Hab 58.6 rkm	2C 60.3 rkm	2A 63.6 rkm	1B 70 rkm
06/20/03	10.1	9.6		9.6	8.6	8.8		8.4	8.4	8.1	8.1
06/21/03	9.9	9.5		13.5	8.7	10.8		9.1	9.4	9.2	8.8
06/22/03	11.7	11.7		16.6	10.1	12.3		10.6	10.6	10.2	10.2
06/23/03	13.1	12.4		22.4	10.5	13.7		11.0	11.2	11.1	10.7
06/24/03	12.3	11.6		17.9	9.8	12.0		10.7	10.7	10.4	10.6
06/25/03	11.5	11.1		14.5	9.2	10.5		10.0	10.0	9.7	9.8
06/26/03	11.3	10.8		18.7	9.1	10.9		9.9	9.9	10.4	9.9
06/27/03	11.5	11.0		17.2	9.5	11.4		10.6	10.6	10.9	10.6
06/28/03	11.8	11.5		17.9	10.3	11.4		10.5	10.5	10.6	10.5
06/29/03	11.0	10.7		12.5	9.6	10.3		9.9	9.8	9.6	9.8
06/30/03	10.4	10.1		14.5	9.6	10.1		9.9	9.9	9.4	9.8
07/01/03	10.6	10.2		11.8	9.6	10.0		9.6	9.6	9.1	9.4
07/02/03	9.9	9.6		9.8	8.8	9.2		8.7	8.8	8.4	8.4
07/03/03	10.0	9.6		9.6	9.0	9.1		8.9	9.1	8.7	8.8
07/04/03	11.0	10.4		11.4	10.2	10.7		10.1	10.7	10.0	9.8
07/05/03	11.6	11.3		11.6	10.4	10.8		10.2	10.3	9.8	9.9
07/06/03	10.9	10.4		10.3	9.6	9.8		9.2	9.3	9.0	8.9
07/07/03	11.2	10.8		13.2	10.5	11.9		10.6	11.2	10.9	10.1
07/08/03	13.2	12.8		15.7	12.0	13.0		11.7	12.3	11.6	11.5
07/09/03	13.8	13.3		16.5	12.4	13.0		12.2	12.7	12.4	11.9
07/10/03	12.7	12.4		13.8	10.9	11.4		11.2	11.2	10.6	10.9
07/11/03	11.4	10.9		16.2	10.7	10.6		10.2	10.3	10.3	10.2
07/12/03	12.3	12.2		18.4	11.6	12.3		11.9	12.0	11.8	11.4
07/13/03	14.0	13.7		23.2	12.9	13.0		12.9	13.0	12.9	12.3
07/14/03	14.4	13.9		18.8	13.0	13.4		12.7	12.8	12.4	14.3
07/15/03	13.8	13.5		19.6	12.8	13.7		13.1	13.0	12.5	14.6
07/16/03	13.1	12.8		17.8	12.3	12.8		12.4	12.4	12.7	
07/17/03	11.6	11.2		13.7	10.6	10.6		10.2	10.0	10.3	